THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXV. No. 1651.] LONDON, JANUARY 1, 1895. [47TH YEAR. PRICE 6d.

JAMES OAKES & Co.,
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Wenlock Iron Wharf, 21 & 22, Wharf Road,
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NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers, and rendering leakage impossible.

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Manufacturing Gas Engineers.

See Advt. p. 7 of this week's issue.

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And at Pharos Works, Hackney Wick.
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REQUIRES NO ATTENTION WHATEVER.
Guaranteed perfectly steady Gauge, no matter how Steam Pressure may vary.
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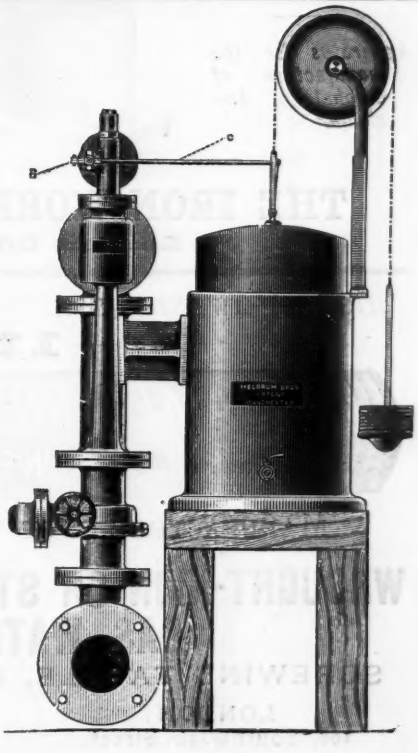

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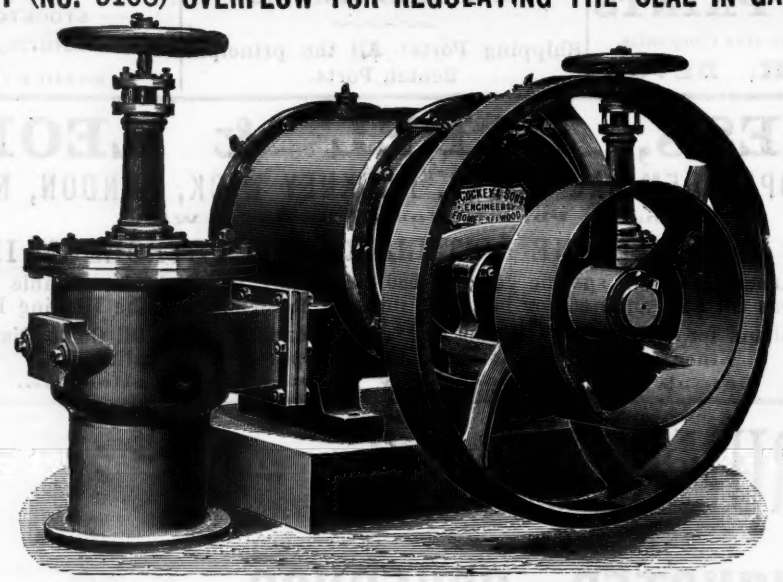

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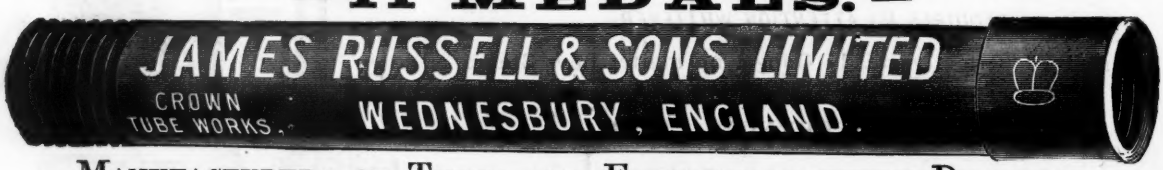

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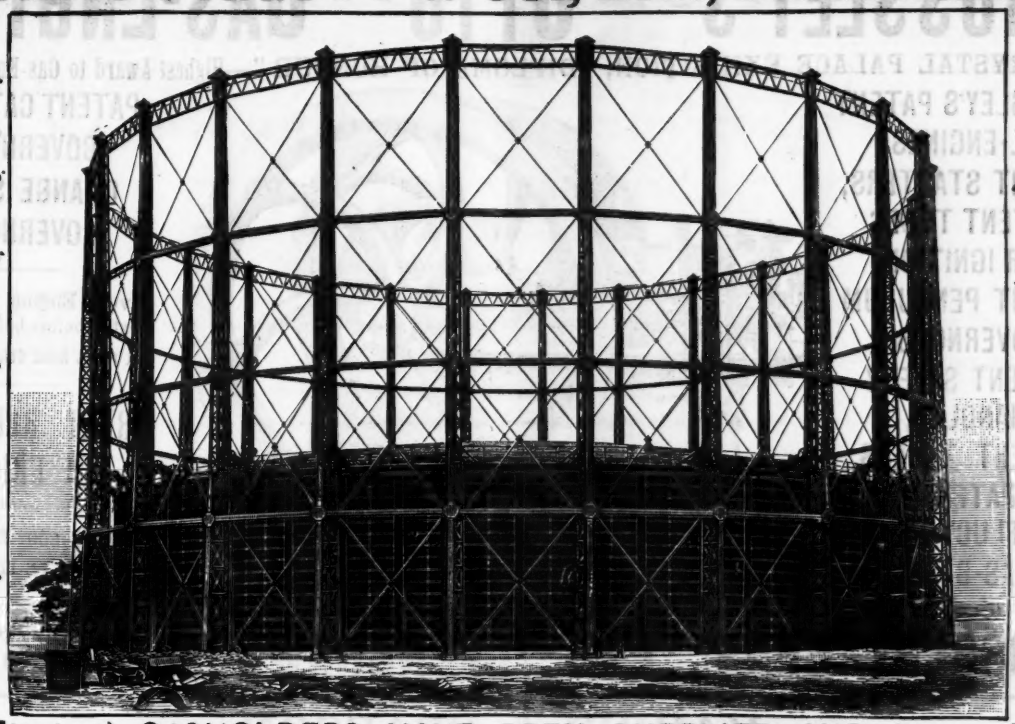

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for working Purifiers,

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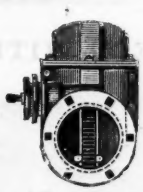

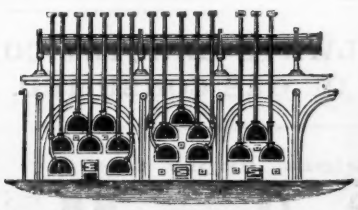

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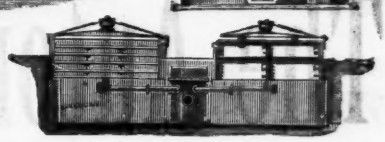

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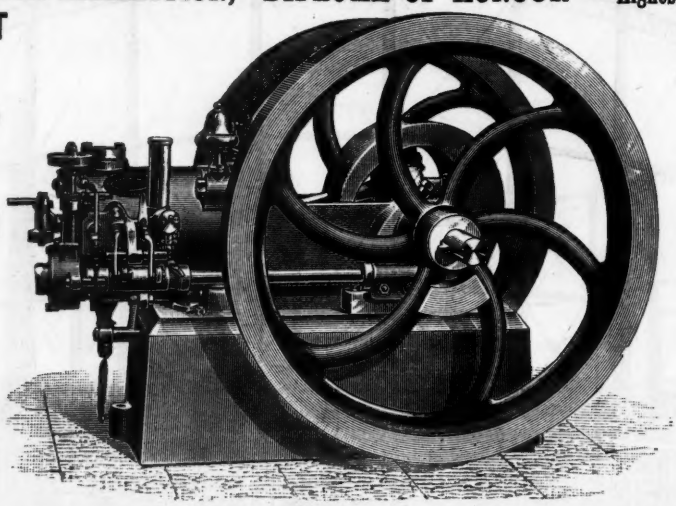

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THAT IS

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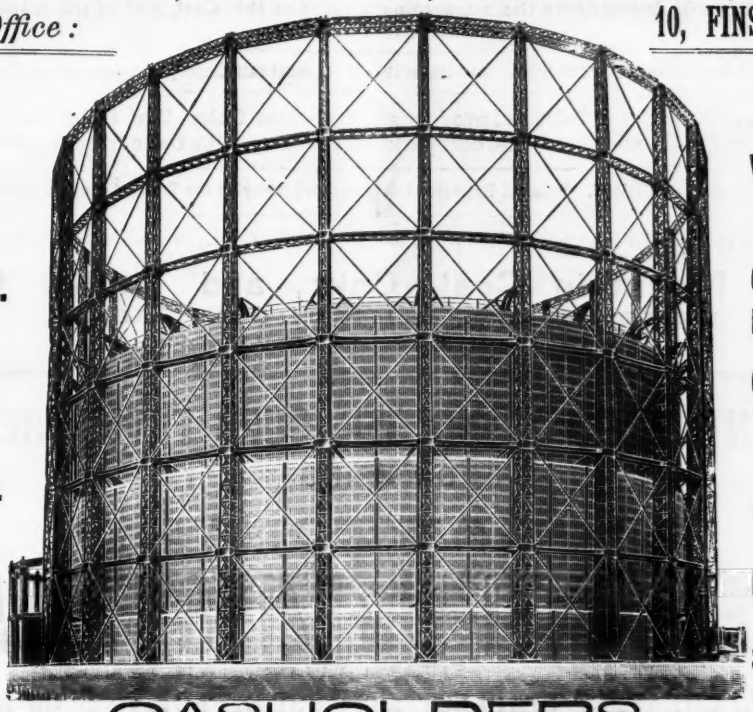

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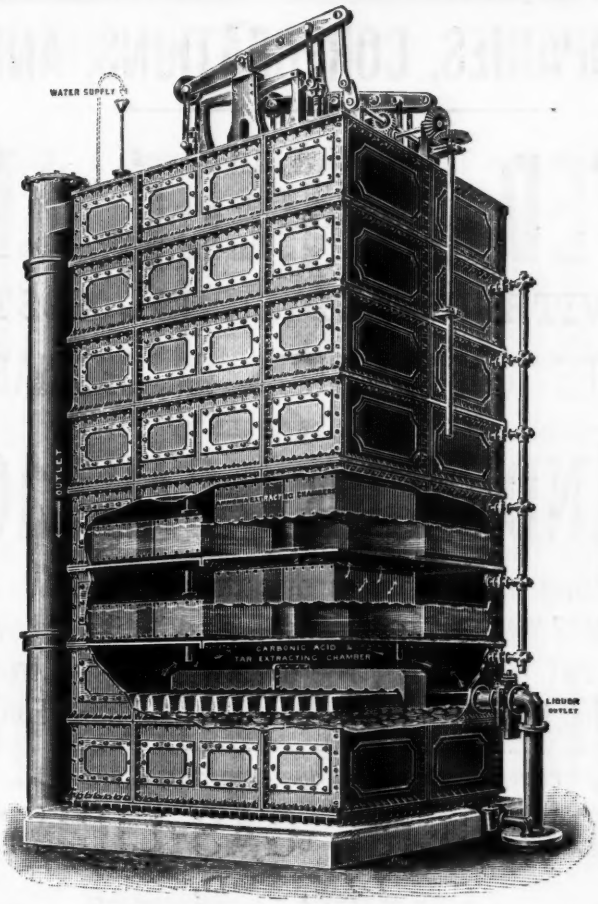
REMOVES ALL TAR & AMMONIA.

And from 40 to 50 per cent. of the Carbonic Acid and Sulphuretted Hydrogen.



REMOVES ALL TAR & AMMONIA.

And from 40 to 50 per cent. of the Carbonic Acid and Sulphuretted Hydrogen.

REMOVES ALL TAR & AMMONIA.

REMOVES ALL TAR & AMMONIA.

Taking the Whole of the Purification between the Condensers and Purifiers.

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The best **KENTUCKY CANNEL** in the Market.

SAMPLE CARGO will demonstrate the extraordinary value of this Coal, and of the resultant Coke and other Bye-Products.

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With THREE to FOUR TIMES the ORDINARY LIGHT,

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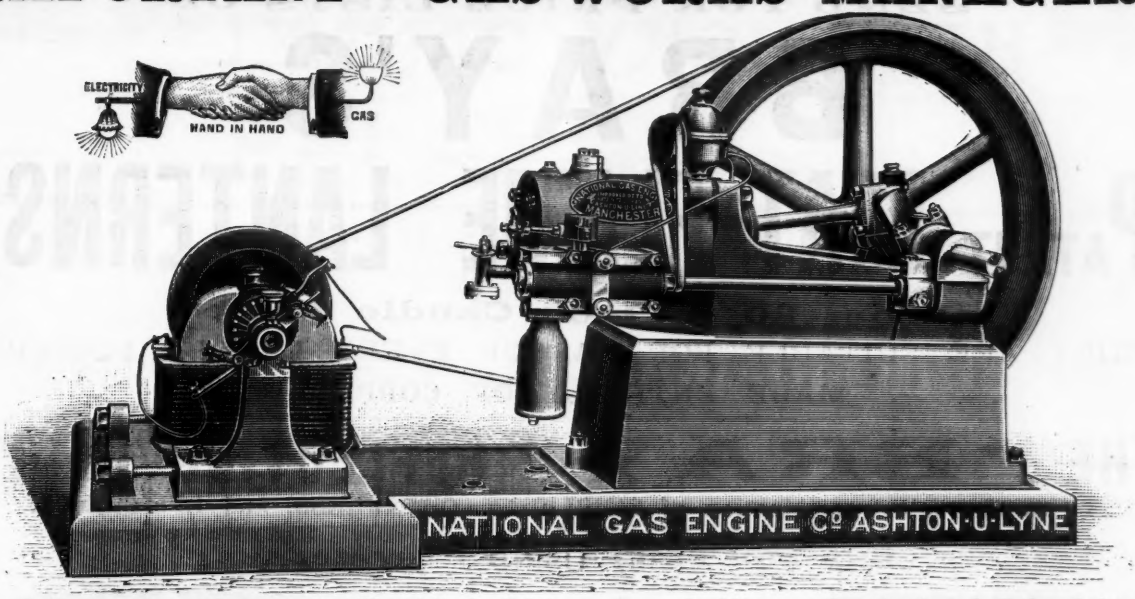

The fast growing tendency to adopt Electricity for lighting purposes should engage the attention of all thoughtful Gas-Works Managers and those interested in Gas Companies.

By the aid of the Gas-Engine driving the Dynamo, **50 PER CENT. MORE LIGHT CAN BE OBTAINED FROM THE SAME GAS;** and thus, by their adoption as the motive power, the gas consumption of the district can be maintained and the light increased.

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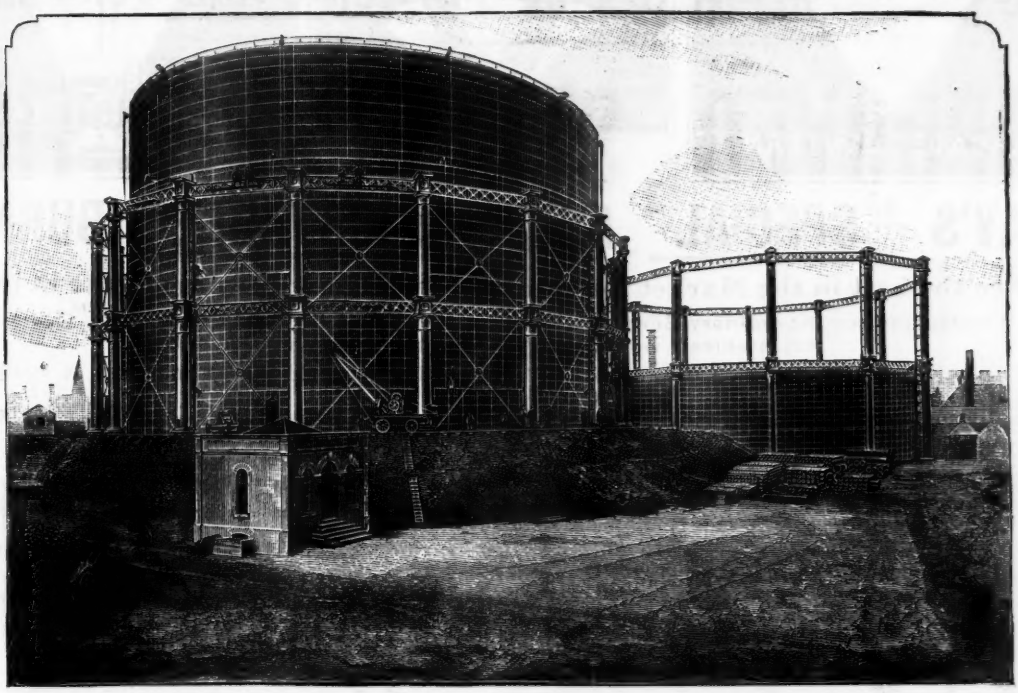

From a Photo. of Four-Lift Holder at the Birkenhead Gas-Works, 160 ft. by 30 ft.

TWO LIFTS added to existing Holder on the ROPE SYSTEM, thereby doubling the Capacity.

NOTE—The Third Lift being controlled by Ropes as well as by the Columns, absolutely level working is assured.

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From 30 to 1100 Candle Power.

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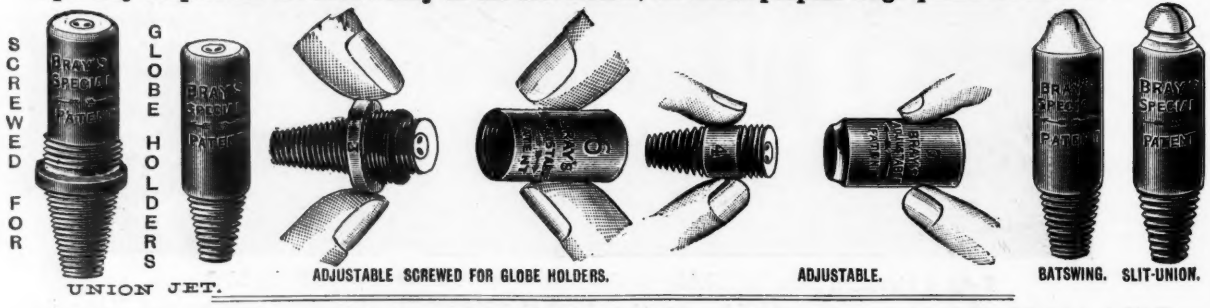
Specially adapted for use with Penny-in-the-Slot Meters, for which purpose large quantities have been sold.



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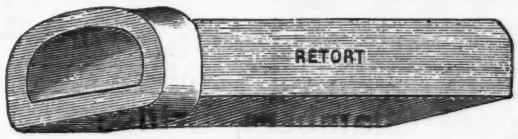

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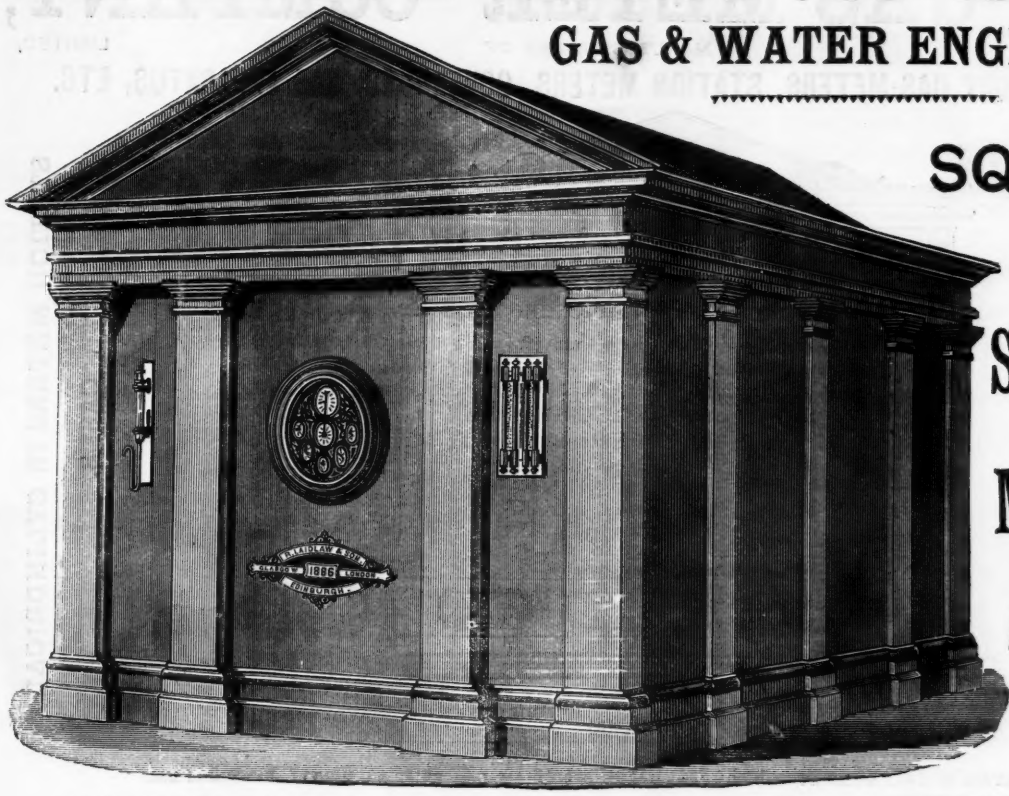

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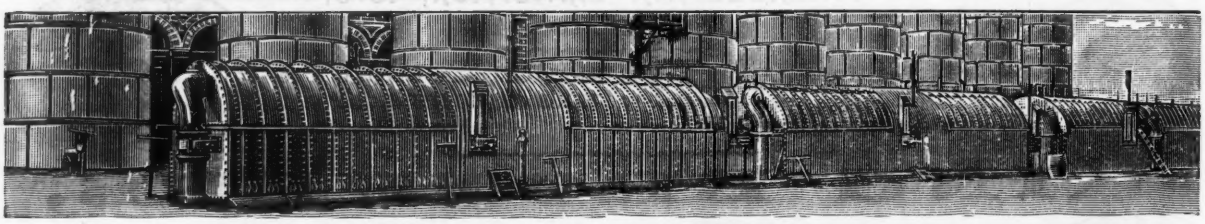
PATENT "STANDARD" WASHER-SCRUBBER

☞ **484** of these Machines (capable of dealing with **464,490,000** cubic feet of Gas daily) in use which fact is given as evidence of this apparatus being the Most Efficient of any in the Market for the extraction of Ammonia, Carbonic Acid, and Sulphuretted Hydrogen from Coal Gas.



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Have been made in large quantities for the last twelve years; and during the whole of that time, have been in regular use at most of the largest Gas-Works in the Kingdom. They possess the excellent quality of remaining as near stationary as possible under the varying conditions of their work—a quality which will be appreciated by all Gas Engineers and Managers. The generally expressed opinion is that these Retorts are the very best that are made.

RETORTS CAREFULLY PACKED FOR EXPORT.

Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

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Analysis: 12,600 feet of 19-candle gas per ton.
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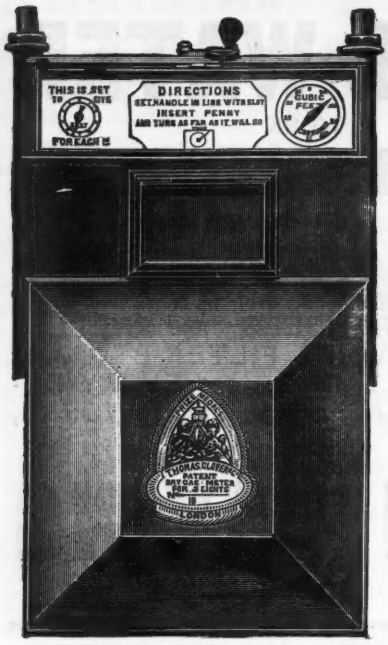

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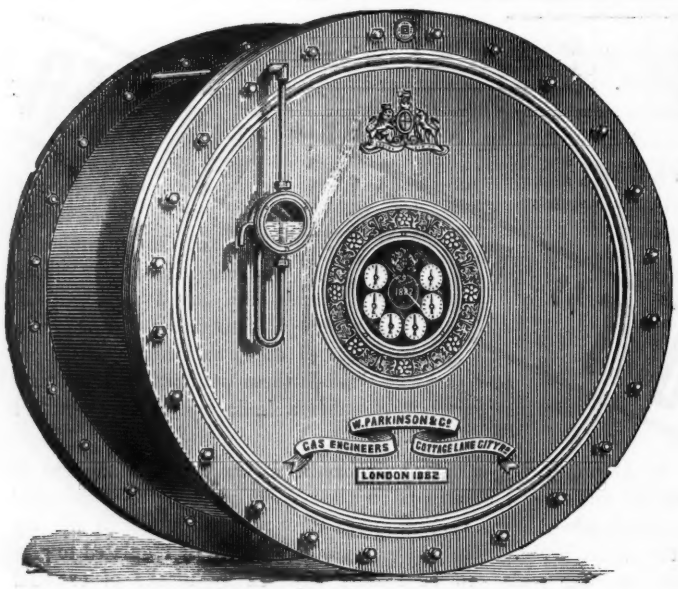

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EDITORIAL NOTES.

A Retrospect of the Year 1894.

IN looking back over the events of the past year, with an obligation to pay particular attention to those which had some bearing upon, or a more or less intimate connection with, the gas industry of the United Kingdom, one is compelled to recognize that, on the whole, the course of the history of the industry during the last twelve months has been smooth, and prosperous in a quiet way. The general trade of the country has not been good. Prices of all staple commodities have sunk to a level never before reached; and, as a consequence, the difficulty of finding profitable employment for capital has been great. The purchasing power of a sovereign in the produce markets of the world has grown enormously during the last twenty years; and the "unearned increment" of those who have money to spend on the necessaries of life, to say nothing of what are often erroneously classified as luxuries, has accordingly attained a high proportion. On the other hand, the speculation market has gone to pieces. Money has become extraordinarily cheap, while the investments that can be depended upon to preserve their capital value intact, and yet return a safe interest, have assumed exorbitant prices. The company promoter has killed the "goose" that used to lay "golden eggs" for him. The lesson of even such well-endorsed schemes as the Manchester Ship Canal is of terrifying import to small investors; and the effect of all this financial tightness, or slackness—the term alters with the point of view—is to put first-class gas stocks at a level that only a few years ago would have seemed unattainable. To take The Gaslight and Coke Company's "A" stock as an indicator of the course of the market, this stock, which started the year at 228, left off before the Christmas holidays at 256. South Metropolitan "C" stock started at 253-258; and it has now reached something like 300. Not in any one year that we recollect has gas property in general improved so much in value. For this remarkable appreciation there are two obvious reasons—one being, as we have just stated, the demand for safe investments; and the other the return of gas shares to popular favour. The public are becoming satisfied by degrees that gas property is secure; and therefore one can hardly say how much higher the best gas stocks may yet go. It is difficult now to buy a good British ordinary gas stock to pay 5 per cent.; while any large gas company can raise debenture capital at something like 3 per cent. At this rate of improvement, the superior cheapness of capital raised for the purpose of a municipal gas undertaking upon the security of the general district rates will soon vanish altogether, if indeed it has not already done so.

The course of the markets for gas-works necessaries and products has tended, on the whole, to favour the industry—that is to say, to facilitate reductions in the charges for gas. This effect has actually been realized in many places, including the Metropolis, Gas coals have been obtainable at reasonable quotations, notwithstanding the attempts, which had some local and temporary success, of colliery proprietors in different districts to form themselves into "rings" for keeping up prices. The strongest gas coal market during the year was that of Durham. Everywhere else the market was absolutely in the hands of buyers; and this had the effect of reconciling many a gas manager to the cannel which he had temporarily abandoned in favour of fluid carburetting material. Coke appears to have sold very well in most places, and tar was not a drug; while sulphate of ammonia attained at one time the astonishing quotation of £14 per ton, though at the present moment the market is "all to pieces" again. Those gas undertakings which had auxiliary water-gas plants rejoiced in an unexpected drop in the price of oil. Thus it cannot be said that the times were particularly hard for gas manufacturers during most of the year; although the action of "rings" of traders in certain gas-works supplies gave much dissatisfaction to gas engineers. The evil was denounced by letters in the JOURNAL from Mr. George Livesey, Mr. Charles Hunt, and others; but, though publicity has put a check upon the operations of the "rings" in question, it would be too much to say as yet

that these organizations have been either destroyed or rendered incapable of doing mischief in the future.

An important element in the circumstances of gas undertakings is the weather. The summer of 1893 was so warm and bright, that those gas-works administrators—and they were not a few—who found their output checked, had no difficulty in establishing the connection of cause and effect between the sunny skies and their diminished receipts. Last year was different in this respect. Nature had to make up the due average, and she went about it in a peculiarly irritating fashion; for while the water-works of the country did not receive the replenishment of rain they needed and expected, the summer was dull and the autumn showery. The result should be to restore to gas undertakings their ordinary and natural rate of growth. During the late autumn, heavy gales and floods prevailed throughout the country; and at Bath, Windsor, as well as in several smaller towns, mainly in the South and West of England, the gas-works were drowned out, and the districts put in darkness for days together.

The enhanced value of gas property already alluded to had the effect of reviving the tendency of municipalities to acquire the local gas undertakings. The municipalization, of the London gas supply was talked about by a party in the London County Council, mainly with a view to procuring an additional source of revenue in aid of the rates; and transfers were actually arranged for, and carried out, at Accrington, Goole, Kendal, Ambleside, Falkirk, and Stourbridge, while several other projects of the same character were put in train for the ensuing session of Parliament. The gas legislation for the year was also noteworthy on account of the abrogation of what is known as the West Ham clause, for limiting the amount of the surplus revenue to be carried forward from time to time by sliding-scale gas companies, and for the further example in stock consolidation afforded by the Plymouth Act. An amalgamation of the Croydon and Carshalton Companies was effected; the operation forming a valuable precedent of the kind. The parliamentary session was not fruitful of general legislation affecting the gas industry. An Employers' Liability Bill would have become law, but for a disagreement between the two Houses as to the advisability of permitting "contracting out." The Government, led by the Trade Union politicians, insisted upon making the measure compulsory; while the Lords lent a favourable ear to the party which preferred the preservation of individual liberty in this respect. So the Bill was lost. The Parish Councils Act, as the Local Government Act, 1894, is popularly called, with reference to its most salient feature, altered the constitution of the highway and sanitary authorities, with whom gas companies have important relations. The Notice of Accidents Act, which specially embraces gas-works in its purview, nominally came into operation at the close of the session; but no proceedings have as yet taken place under its provisions. The year was barren of gas litigation sufficiently important to be referred to here.

An agitation of gas consumers in the northern portion of the Metropolitan district of The Gaslight and Coke Company, started towards the close of 1893, came to a head during last year in the shape of several interparochial "congresses" and a deputation to the President of the Board of Trade; the cause being dissatisfaction with the statutory arrangements whereby different prices are chargeable by the Company for gas supplied in Middlesex and in the Surrey district which formerly belonged to the London Gaslight Company. The circumstances of The Gaslight and Coke Company have necessitated their making a difference of 6d. per 1000 cubic feet in these charges; and this is strongly resented by those consumers who are required to pay on the higher scale. A Board of Trade inquiry into the matter was petitioned for; but it was refused on the score that there is no legal power to hold an investigation into the working of the Acts of Parliament and Schemes of Amalgamation regulating the gas supply of the Metropolis.

"Labour" questions have been much debated during the year; and the JOURNAL has contained many contributions towards the settlement of public opinion respecting disputed points of industrial and social economy. Circumstances have proved too strong for those who would have upset the compromise by which the great coal strike of 1893 was terminated. The Conciliation Board, under the presidency of Lord Shand, has justified its existence; while a strike of Scotch miners, which resulted disastrously for the men, showed once more what power for mischief, reckless and self-seeking agitators occasionally exercise. The incident also illustrated how far the dream of the so-called "Solidarity of Labour" is from being a reality. The newer Trades Unions—those which were ostentatiously formed for "fighting purposes"—lost power during the year, greatly owing to their failure to secure any tangible good for their members, and the heavy drain upon their resources for the support of the professional leaders. Certain outrages attendant upon the introduction of retort-working machinery into the Plymouth Gas-Works—a hotbed of Trade Unionism—were interpreted as having some connection with this movement; but the connection was not established. The Trade Union Congress met at Norwich, and made itself more ridiculous than ever by passing impracticable resolutions of a Collectivist cast. While the Legal Eight-Hour Day was warmly advocated by Social Democrats and Trade Unionists as a means of reducing the number of unemployed and diminishing production, the success of a 48-hour working week, as a boon to the workmen and not involving any falling off in production, was claimed to be demonstrated by the result of a year's trial at the Salford Iron-Works. The system was therefore adopted in the Government dockyards and arsenals. The Royal Commission on Labour terminated its inquiry, and presented a set of reports which form a small reference library of authorities on the subject. Labour troubles of an acute and dangerous type were rife in the United States during the summer.

The Board of Trade Committee on Standards of Light continued sitting throughout the year, but did not produce their report. Consequently, the gas industry is still without an authorized substitute for the parliamentary standard candle. Dissatisfaction with the Metropolitan gas-testing arrangements caused a demand to be addressed to the Referees to "prescribe" the candles to be used for this purpose, according to the terms of the statute in this case made and provided. The Referees attempted the task of specifying the standard candle; but the result was a failure, and the order was withdrawn. The state of confusion into which the practice of gas photometry in the Metropolis has now fallen may be appreciated from what we believe to be the fact of there being something like thirteen or more different patterns of photometer in use at the testing-stations every day. Meanwhile, the search for a generally acceptable standard of light continues in all parts of the civilized world. Several physicists have suggested the employment for this purpose of a screened-off portion of the area of the "crater" of an electric arc lamp. A proposal has been made for rehabilitating the discredited platinum standard of light. Mr. Vernon Harcourt brought forward a new pattern of the 10-candle pentane standard. The Dutch Photometrical Commission published an instructive report on the general subject, the principal features of which were noticed in our last two issues; and the amyl-acetate lamp standard became established in the favour of German photometrists.

There was no absolutely new invention or process introduced into either gas manufacture or utilization last year; but several comparative novelties of both orders made good progress. Carburetted water gas advanced considerably in favour with English gas engineers, in consequence of the good showing made by this auxiliary at Belfast, as laid before the industry in general in a remarkable paper read by Mr. James Stelfox before the Incorporated Gas Institute. The Young and Bell oil-gas process also improved its position; but the return of cannel to low market prices seriously affected the trade in, and the application of, certain processes of gas enrichment by volatile hydrocarbons of which a good deal has been heard of late years. As bearing upon the subject of gas enrichment, it may be recorded here that, with the permission of the London County Council, the South Metropolitan Gas Company sent out, as an experiment, during a fortnight in the early summer, nothing but common coal gas *au naturel*—that is to say, gas made from the ordinary run of Durham coals found most suitable for the London gas coal market, without adventitious enrichment of any kind. The results of this experiment were duly claimed by the Company as showing that artificial enrichment is unnecessary; but a very different interpretation was put upon the same indications by the Superintending Gas Examiner to the County Council. A fresh school of

gas engineers sprang up, headed by Mr. George Livesey and Mr. Newbigging, in connection with the parliamentary proceedings on the Plymouth Gas Bill, who maintain the thesis that what is known as "low-grade gas" is the best for general consumption. Their case will be found fully expounded and discussed in the JOURNAL for the period. The use of incandescent gas-burners and the introduction of automatic prepayment consumers' meters increased last year "by leaps and bounds," so as to become prominent features of the year's technical history. The former cut deeply into the select class of business marked out by the electric lighting interest for its own; and accordingly the system was favoured with a bitter vilification by a few noisy electricians, who tried to make out that the use of incandescent gas-burners is prejudicial to health. The attack from such a quarter, however, only served to advertise the subject of it, and completely failed of its object. The latest advance of the incandescent gas-burner is in the matter of street lighting. As to the popularity of the automatic prepayment meter system of introducing gas among the artizan class of householders, it can only be properly described as astonishing. Thousands of the instruments are being made and put in use every month, in all parts of the kingdom; and although gas managers have had some disagreement with the makers on the subject of the length of time for which these novelties should be guaranteed, there was nothing to check the course of the movement. The greater number of these meters are different patterns of the "penny-in-the-slot" arrangement; but other systems are in use.

While upon this subject, it will be convenient to mention that, as a consequence of negotiations that were conducted during the last weeks of the year between leading gas engineers and representatives of the meter trade, an arrangement was concluded which bids fair to place the business relations of purchasers and manufacturers of meters upon a sounder footing than any that has previously existed in this trade.

The past year was also marked by some attempts, largely successful, to improve atmospheric gas-burners, as applied to gas-fires, in the direction of noiselessness and diminished liability to "fire-back." Gas-engines are improving and growing in power by degrees; but the hot-cylinder or impulse engine is still to seek. In gas manufacture, the advance to be noted most particularly is in the matter of retort-stoking machinery. Sloping retort practice has made little, if any, advance; while hydraulic, pneumatic, and steam-power carbonizing machines, for application to horizontal retorts, occupy a stronger position than ever they did. Every new retort-house of any magnitude that is built in the land is now fitted with something fresh and promising in the "conveyor" line, with the object of reducing the manual labour of shifting coal and coke.

There were no serious accidents or casualties last year referable to causes connected with gas making. Gas explosions in consumers' houses there were, of course, as usual; and some instances of gas poisoning were recorded. The most disturbing instances of gas explosions, however, arose in connection with defective electrical distribution systems. Examples of this order of gas casualty occurred several times in London and Glasgow; and a specimen from Southampton of a gas service-pipe perforated by an electrical short circuit, was exhibited at the autumn meeting of the Southern District Association of Gas Managers, and illustrated in our columns. All these pieces of evidence point to the conclusion that in the underground electrical distribution arrangements now introduced into many English town there is an additional risk to life and property. Much uneasiness was created during the year among the general public by the growing frequency of petroleum lamp accidents; but nothing was done in the matter by the authorities, besides warning the public to exercise care in selecting proper lamps.

The year's record of the various technical institutions and associations connected with the gas industry is good, save for the regrettable continuance of disunion in the ranks of followers of the industry, as evidenced by the co-existence side by side, if not upon the same ground, of two national technical organizations. The Incorporated Gas Institute held a most successful meeting in London under the genial presidency of Mr. John West; and the same may be said for the younger Incorporated Institution of Gas Engineers, of which Mr. Alfred Colson was President, with the addition that the latter body held a second meeting in September, at Leicester, when the President's arrangements touched the high-water mark for hospitality and real public spirit. Naturally, both these organizations claimed to have gained ground during the year. The various District Associations of Gas Managers maintained their usual level of serviceability and pleasantness, and were the means of contributing a fair quota to the original technical literature of the industry for the year. The general scientific societies of the country were active; but the only epoch-marking discovery which any of them can be credited with aiding to publish to the world was that of an alleged new component of the atmosphere, announced by Lord Rayleigh at the Oxford meeting of the British Association for the Advancement of Science. This constituent has only been isolated in very small quantity up to the present time. Its leading characteristic appears to be its particularly exclusive nature; for it will not enter into combination with any element that has yet been introduced into its company. We have learnt of late years to pay such respect to the "infinitely little," that it would be rash to speculate upon the import of Lord Rayleigh's discovery. A suggestion was made early in the year in the columns of the JOURNAL for the formation of a Gas Undertakings' Association, somewhat on the lines of the defunct Gas Companies' Association. The same idea was made a salient feature of the annual report of the Council of the Incorporated Gas Institute; but as yet nothing has come of either of these promises of movement in the direction indicated.

The death-roll of the British gas industry has been long for the past year; and is signalized by many names both of veterans who have passed away to "where, beyond "these voices, there is peace," and also of active workers removed from the scene of their labours in the midst of their toil and endeavour. Mr. John Hutchinson was identified with the gas supply of Barnsley, and was one of the founders of the British Association of Gas Managers. Mr. H. F. Willey, of Exeter, did much for gas engineering and mechanics in the West of England and South Wales districts. Mr. John Field was an accountant whose labours in the region of gas supply statistics, published in his well-known "Analyses," were of world-wide fame. Mr. J. Burgess, of Huddersfield, was a representative of the old North Country school of gas managers, of whom few remain upon the active list; and Mr. David Swallow was another. Mr. E. Horner, late Chairman of the Phœnix Gas Company of London, was a link between the present and pre-amalgamation days. Dr. Schilling was acknowledged the head of the profession in Germany. Mr. F. W. Clark was one of the most ardent and ingenious spirits who ever adopted gas engineering and chemistry as a study and a vocation, and was at the time of his death the best authority upon carburetting coal gas by means of petroleum spirit. Mr. James Lupton, of Leeds, had long been a valued officer of the Corporation, and of the Gas Company before them. Last to be removed was Mr. George Garnett, of Ryde, whose death took place quite suddenly as the year was drawing to an end. The retirement of Mr. Robert Jones from official connection with the Commercial Gas Company closed a long chapter in the history of the undertaking.

There is little more to be said as to the state of the gas industry during the past year. Turn we now to the opening of the one that lies before us, in the confident hope that good work will never go out of date, and that, as the years roll by, the great gas industry of the United Kingdom, and the JOURNAL in which its chronicles are published week by week, may grow together in activity, scope, and value in and to the community they serve.

Mr. B. Haynes.—We greatly regret that, relying upon information sent by a regular correspondent, an unfounded announcement appeared in last Tuesday's JOURNAL of the death of Mr. Benjamin Haynes, the Engineer and Secretary of the Stretford Gas Company. We are pleased to learn from Mr. Haynes, jun., that though his father has been seriously ill, he is "now in a fair way to recovery." The letter on which our paragraph was founded was dated the 20th ult.; and in the course of it our correspondent said: "I hear this morning that Mr. Benjamin Haynes, of the Stretford Gas Company, died rather suddenly yesterday."

WATER AND SANITARY AFFAIRS.

The Principal Events of the Year 1894.

THE year 1894 opened with the prospect of an active parliamentary campaign respecting the water supply of the Metropolis. Among other measures bearing on this subject was the London Water Bill of the County Council, intended to confer on that body the power to purchase by agreement, or take on lease, any water-works or water-rights in any part of the country, with a view to the future water supply of London and its neighbourhood. This scheme speedily received a check; being found by the Examiner of Petitions for Private Bills to be so framed in regard to finance as to go beyond the statutory notice. Hence a difficulty arose on Standing Orders; and the Council ultimately saw fit to withdraw the Bill, though intending at one time to support it before the Standing Orders Committee of the House. The Thames Conservancy Bill, brought forward by the Conservancy Board as then constituted, proposed certain changes in regard to that body, and a very large increase in the contributions to be levied on those of the London Water Companies who derive a supply from the Thames. The Bill was one of very formidable proportions; having upwards of three hundred clauses. During its progress through Parliament, the additional payments from the Water Companies, as set forth in the Bill, were reduced in amount so as to be £7500 instead of £12,000 per annum. This, however, made a heavy total; the future payments becoming £25,450 in place of £17,950, and accompanied with no permission to draw an increased supply of water; though the grant of a power of intersale between the Companies may serve as a relief, and some benefit may accrue from the circumstance that henceforth the Companies will have a representative on the Board. Yet the latter privilege seems small compared with the presence of six representatives from the London County Council, and a like number from the Corporation. Early in the year, a strategic movement was attempted by the County Council, in the shape of certain proffered negotiations with the Water Companies for the purchase of their undertakings. Lord Farrer, with rather indiscreet candour, expressed his approval of this proceeding, because it would place the Council in a better position for opposing the Bills which the Companies were bringing into Parliament. As might be expected, and as the Council themselves doubtless anticipated, the Companies showed little or no inclination to enter into the proposed negotiations, especially as the Council had laid down for a basis that "no monopoly right" on the part of the Companies should be recognized. To formulate any such condition was to interpose an insuperable barrier at once; and so the negotiations failed at the outset. Neither did the pretext thus manufactured by the Council answer any purpose in opposition to the Companies' Bills. These were three in number—the East London, the Southwark and Vauxhall, and the West Middlesex—all seeking for an increase of capital, with a view to the extension of works; the aggregate amount being as much as £1,750,000.

The progress of these three Bills in Parliament was remarkable. The East London Bill had been rejected by the House of Commons in the previous session; not even being allowed to pass the second reading. But the rejection was so obviously due to purely party tactics, that Parliament itself could not complain at the reintroduction of the measure. This time better success awaited it, though it had a narrow escape. There was opposition from the Government, evidently at the instigation of Spring Gardens. Procrastination was preached, on the plea that a comprehensive scheme might be framed later on, either by the Council or by the Companies. But the East London Bill was carried on the second reading by a majority of one; and as the Council considered it unadvisable to proceed with further opposition at that stage, the other two Bills passed their second reading also. But they were opposed before the Select Committee of the Commons, and again in the Lords. Heavy costs were incurred by all the parties concerned—comprising the ratepayers on the one hand and the Companies on the other; with the result, after all, that the Bills received the sanction of the Legislature substantially in the form in which they were first presented. The issue of the contest was remarkable; and we may add that it was significant. Attempts had been made to show that the schemes connected with the Bill, especially in the case of the Southwark and Vauxhall Company, were contrary to the recommendations of the Royal Commission which had recently reported on the water supply of London. But the decision arrived at in Parliament must be taken as showing that, in the opinion of the Legislature, the plans of the Companies were really in accordance with that report. There was also physical proof forthcoming that the water supply of London and its environs needed to be promptly enlarged, especially in the district of the East London Company, where General Scott had apprehended the approach of scarcity some years before. The opponents of the Southwark and Vauxhall Bill attempted a diversion, by contending that the Royal Commission had recommended the plan proposed by Messrs. Hunter and Fraser, for the construction of extensive reservoirs in the neighbourhood of Staines. But no Bill for such a purpose was before the House; and the cost of the Staines scheme in its entirety was estimated at ten millions sterling, though it was intended to be executed by instalments, as necessity arose. The Southwark and Vauxhall scheme had a great resemblance to that of Messrs. Hunter and Fraser, but had the advantage of a shorter line of communication from the intake, and was, of course, on a smaller scale.

The idea mooted by Mr. Shaw Lefevre, that either the County Council or the Water Companies might elaborate "a definite scheme and a definite policy" on an enlarged plan, was practically set aside by the success which attended the three Bills of the Companies, unless it be that the purchase of the existing undertakings by the Council is one way of fulfilling the expectations entertained by the President of the Local Government Board. Seeing the futility of their opposition to the Companies, the County Council early in July resolved on bringing eight Bills into Parliament in 1895, for the purchase of the eight Metropolitan water undertakings. The idea of "purchase" seems rather remote from the terms contemplated by the Council. Capital expenditure enters not into the reckoning; neither does income. The Council seek to acquire possession by paying for just so much of the works as they think will serve the present purpose. It is simply taking so much plant and machinery at a valuation. The *modus operandi*, in the absence of agreement between the Council and any of the Companies, is designated "arbitration." But it is arbitration under conditions, and these conditions of such a nature as virtually to set the price beforehand. There is a curious provision in the Bill which has reference to the New River Company, stipulating that, if the Council should so require, the consideration to be paid for the "transfer" shall be in the form of a half-yearly or other periodical payment, charged upon the county rate for a period of not less than eighty or more than one hundred years. This singular clause does not occur in the Bills relating to the other Companies. We miss from all the Bills the absurd restriction contained in the statutory notice, that the Arbitrators should make no allowance for any "past "increase" in the rateable value of buildings, except as caused by alterations or additions involving an increased supply of water. But the proviso still extends to a rise in rateable value in the future. Also no additions are to be made to what is called "the fair and reasonable value "of the undertaking" in respect of compulsory sale. The consideration to be paid by the Council for the transfer of the undertaking is to be the value ascertained after allowing for the liability involved in regard to the debenture stock. One Arbitrator is to be appointed by the Council, and one by the Company; and these two are to appoint a third, who, if necessary, is to be the Umpire. The Arbitrators may also appoint an Assessor. Among the conditions under which the Arbitrators are to act, is that of considering the probable necessity of the introduction of a new source of supply. Regard is to be had to the deductions to be made in respect of works which have become wholly or partially useless; and there is to be an adjustment of the Company's revenue account in respect of repairs and renewals "properly chargeable thereto." The objectionable character of this scheme of purchase or "transfer," both as affecting the ratepayers of the Metropolis and the security of joint-stock undertakings generally, is becoming the subject of discussion in the columns of *The Times;* and the alarm thus excited is calculated to increase.

The eight purchase Bills are obviously such as call for

strenuous opposition on the part of the Water Companies, for arbitration and not agreement must be looked upon as the sole outcome should the Bills pass. In reality, a costly and useless parliamentary struggle is the only prospect. In strange opposition to the idea of purchase, the County Council are seeking for a new source of supply. Wales is mentioned as the chosen locality; while some spot situated elsewhere seems to be also under review. When the Council had to face defeat in the past session, and were constrained to withdraw their Water Bill, the Committee who had charge of that measure stated that the delay to which they were subjected by losing the session of 1894 would enable them to prepare and submit to the Council "a definite scheme, complying with the ordinary "requirements of Parliament in similar matters, as regards "the deposit of plans and sections." With these intentions, the Committee said: "We hope to be ready with pro-"posals for a Bill to be introduced next session." The hope is not realized; and the "definite scheme" stands over for yet another year. Far more hopeful than these visionary projects of the Council, we have two Bills promoted by London Water Companies. One emanates from the Lambeth Company, seeking power to raise £500,000 by the issue of debenture stock—the capital so obtained to be applied to the extension of works, including two new reservoirs at Molesey. The other Bill is promoted by the Chelsea Company, to raise £50,000 by means of debenture stock, to defray the cost of an additional filter-bed and other works. The Companies have no option but to provide for the fulfilment of their statutory obligations, whatever may be the ideas entertained by the County Council. It may even come to pass that, in the course of a few months, the Council will be composed of different elements from those which now characterize that body; the result being a general change of front. It remains to mention that a Bill of a dubious character as affecting the water supply is to be brought in by the City Commissioners of Sewers, and points to some further use of the artesian well recently constructed by that body.

In the month of October, the great water-works at Thirlmere became available for furnishing a supply to Manchester. The event was marked by a twofold ceremony—one being the turning on of the water from the lake into the aqueduct; and the other, a day later, being the delivery of the water into the mains of the city. After nearly eight years of labour, and the expenditure of above £2,500,000, Manchester obtains an immediate supply, supplemental to its previous provision, to the extent of 10 million gallons per day—a quantity capable of being augmented to 50 million gallons, each 10 million gallons per day beyond the present amount being estimated to cost somewhere about £1,000,000 for additional pipes. In 1893, Manchester was threatened with a water famine; showing that the Thirlmere works were commenced none too soon. A similar and even severer visitation befell Leicester in the past year; the reservoirs running so low as to approach entire exhaustion—rendering it necessary to employ private wells in aid of the public supply. Leicester had been warned of its danger; but the authorities were slow to act, and commenced works in 1890, or somewhat later, which should have been taken in hand long before. But the lack of rain in 1893, and in part of the past year, took effect on other localities, even including the eastern part of London and the contiguous country. The absolute necessity of providing for the maximum consumption and the minimum rainfall has to be recognized in planning and extending works for the water supply of towns. Among the Acts obtained by local authorities last year was one by the Corporation of Cardiff, conferring power to raise £350,000 for water-works purposes. But the Corporation had so thoroughly realized the wants of their locality, that of this sum they had already expended £133,000. The Gloucester Corporation obtained power to construct additional water-works, to be completed within ten years; the borrowing of £45,000 for such purposes being authorized. In pursuance of an Act passed in the recent session, the Neath Corporation have acquired the undertaking of the Neath Water Company—paying £46,000 for the transfer. It is worth noticing that the Act authorizing the transfer provides that in future the term "annual value" shall mean the gross estimated rental. Any deficiency of revenue is to be made good by the levy of a special rate. The Newcastle and Gateshead Company obtained an Act which included the raising of capital to the extent of £500,000; and the Consett Company were in like manner authorized to enlarge their share capital by £250,000. Concerning provincial schemes of water supply to be brought forward in the coming session, attention has already been drawn in our columns to those which relate to the valley of the Little Don—a region which is likely to be the subject of a complicated parliamentary contest, exemplifying what is called the "grasping and grabbing" policy. There are other Water Bills; but they do not call for special notice at the present moment.

Death of Mr. J. Wilson, of Saffron Walden.—The recent death is announced of Mr. John Wilson, who was for many years Borough Surveyor of Saffron Walden, and Secretary to the gas and water undertakings of the Corporation. Deceased was in his 47th year; and he had been Surveyor since 1869.

Presentation to Mr. W. C. Wigley.—A few days before Christmas, Mr. W. C. Wigley, of The Gaslight and Coke Company, was the recipient of a highly gratifying testimonial of his popularity, in the shape of a handsome silver salver, suitably engraved, subscribed for by the whole of the officers and workmen connected with the meter and stove department of the Company (of which he was until recently the head) at Haggerston. The presentation was made by Mr. G. F. L. Foulger, the Company's Distributing Engineer, in a felicitous speech; and t was duly acknowledged by Mr. Wigley, who has been appointed by the Directors Chief Iuspector of the Central Division.

Business Changes.—Consequent upon the death of Mr. Alfred Williams, the business of Messrs. Alfred Williams and Co., of Bankside, will now be carried on by his partner, Mr. Matthew Mildred, under the old style. The term of the engagement of Mr. W. H. Bale, who was for some years connected with the firm, having expired, Mr. Alfred Collinson (a gentleman who has had considerable experience in the erection of gas and water plant) has been engaged to succeed him. Mr. Bale has entered into partnership with Mr. W. A. Hardy; and they have commenced business as engineers and contractors for gas, water, and other works, at Bridge House, Queen Victoria Street, E.C.——The offices of Mr. A. F. Phillips, M.Inst.C.E., have been removed to 38, Parliament Street, S.W.

Electric v. Gas Lighting in Paris.—The *Electrician* says the lighting of the Champs Elysées, which is now carried out by gas, is to be changed, and electricity employed. The light is to be supplied by 35 arc lamps, placed 50 metres apart; the cost of erection and maintenance being 8190 frs. The cost of the current has been estimated at either 45,233 frs. or 13,715 frs., according as one or the other of the following plans is adopted: (1) The light to be available all night all the year round at 40 c. per lamp per hour—a fixed sum of 8 frs. per lamp per annum being charged in addition by the City for maintenance. The sum of 53,472 frs. thus arrived at is then reduced to 45,233 frs. by the economy of 8239 frs. in connection with the gas lighting. (2) The second scheme relates to special lighting from April 1 to Oct. 31, up till 12.45 at night. The figures are: Current, 15,386 frs.; maintenance, 280 frs.—total, 15,666 frs. Deducting the gas bill 1951 frs., there is left a sum of 13,715 frs.

Wind Pressure in the Recent Gale.—Mr. W. Chew, of Blackpool, has sent us a few particulars as to the rate of travel and the pressure of the wind, as registered in the Mount Grounds in that town, during the gale on the 22nd ult. In the 13 hours between 4 a.m. and 5 p.m. the wind travelled 1250 miles, being an average of 96 miles an hour, and with a pressure equal to 46 lbs. per square foot. From 10 to 10.23 a.m., the wind travelled 50 miles; being equal to 132 miles an hour, and a pressure of 87 lbs. per square foot. The severest part of the gale was from 9 to 11 a.m., when the wind blew from west to west-north-west, about which time the velocity was 111 miles an hour, and the pressure 61¼ lbs. per square foot. During the storm, the 70-feet span slated iron roof of a local works was lifted 12 inches off the walls and dropped again with but little injury. The 100-feet span roofs at the gas-works, with anchor-bolts (15 feet), never stirred; while the three-lift holders were partly up.

The Coal Resources of New South Wales.—At the Imperial Institute, on the 20th ult., Mr. J. Inglis read an interesting paper on the coal and other mineral resources of New South Wales. Sir Saul Samuel presided. The lecturer pointed out the great mineral wealth of the colony, and referred to the progress which, with the help of the local Government, has been made during recent years in the system of mining generally through the application of modern machinery and the spread of technical education. The colony was, he said, very rich in coal deposits; and the chief coal districts—Newcastle and Bulli, north and south of Sydney—had up to 1892 produced coal of the value of £27,000,000. The recent discovery of a very fine coal-field at Port Jackson, in a remarkably favourable position commercially, would lead to a cheap coal supply, and would thus give a great impetus to all the industries in the colony, and vastly increase the importance of Sydney as a port. The lecturer also referred to the importance of a cheap coal supply in the colony leading to a reduction of freights, which, he said, would greatly increase shipping facilities, and might affect the food supply of England.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 41.)

It was not to be expected that Christmas week would be remarkable for business; and, with two closed days in the middle of it, business on the Stock Exchange has suffered accordingly. Had it not been for the boom which is proceeding in South African mining adventures, things would have been very quiet indeed. It was settlement week; and the large operations which have been transacted in "Kaffirs" made it a busy time for those engaged in them. As for other departments, there is not very much to note. The gilt-edged division flourished as usual; and Consols made a fair rise in the week. Home rails were in good favour; but the depressed Americans remained without anything to cheer them. In the Money Market, the periodical requirements of the time provided some occupation for money; but there is nothing within view to indicate the approach of any real change. The Gas Market was very quiet indeed; so much so that there is scarcely any feature to note in connection with it. The most enduring characteristic is its persistent firmness; and though there have been but very few changes in quotations, the tendency is still clearly upward. In Gaslights, the "A" stock, after a few transactions at 253½, closed at 255—the top price. The 6 per cent. preference also realized the best figure. South Metropolitans again gave evidence of their buoyancy; and the debenture stock even added a rise of 2 to its great advance of the previous week. It is evident that the quotations of other choice debenture stocks require reviewing. One bargain in Commercial old at top price was the sum total of business in that Company. In the Suburban and Provincial division, what few transactions were recorded showed no special feature. The Continental group were firm; the prices marked being good all round. None of the rest were prominently in evidence. The Water Companies could scarcely have been more stagnant; for only three or four transactions were effected throughout the entire list, and quotations are only affected by slight *ex div.* variations. A novel incident in connection with the Chelsea Company may be noted. It has commenced to pay an excess dividend, beyond its ordinary 10 per cent., in respect of back dividends which fell below that rate. Hitherto the Kent was the only Company which had arrived at a position enabling it to make such a payment. The excess rate now paid by the Chelsea Company, however, is only ⅛ per cent.

The operations of the week were so limited, and so devoid of all salient characteristic, that they do not require any noting day by day.

THE ELECTRIC LIGHTING INDUSTRY IN 1894.

In reviewing the position of the electric lighting and power industries at the close of the year, as compared with their condition at the beginning, we are met with the difficulty that there is nothing so salient in the mental picture as to be susceptible of effective statement in black and white. Generally speaking, the principal established central station undertakings have increased their lamp connections—in some cases largely; and where this has happened, it has been found necessary to put more capital into the business. The stocks of a few of these concerns stand very well in the investment market; the ordinary shares of the principal Metropolitan electricity supply companies, such as the St. James's and the Westminster, commanding a substantial premium. On the other hand, the disastrous failure of the ambitious Deptford scheme, and the poor prospects of many of the second-rate London and Provincial companies, have become apparent; and it is notorious that few of the electrical plant manufacturing companies are paying their way out of industrial profits. There have been several heavy failures of this class of traders; and more must go the same way ere long. The long expected development of electrical traction has so far failed to appear; and the trade in electric propulsion for vessels has greatly fallen off. An attempt has been made to show that electrical cooking apparatus can be used in a practical way; but there is little prospect of any electric lighting company getting together a paying day connection in this branch. The same may be said of electrical power distribution; for although current has been offered for this purpose in several places at half the lighting rates, no commercial success has been achieved in this direction.

Many new electric lighting undertakings were started and put in hand during the year in different parts of the country; and a number of local authorities are committed to enterprises of the kind. But, after all, the rush into this business has not been so great as was expected; and it is now fast slackening. From the list of notices of intended applications for Provisional Orders in the ensuing session, it appears that there are only 32 electric lighting and 13 traction schemes awaiting the attention of Parliament; and of the former most are very small affairs. The success, such as it is, which has rewarded the promoters of the City and South London and the Liverpool electrical tramways has led to the inauguration of two or three similar schemes of the kind; and one or two "trolley-wire" electrical tramways are reported to be at work in the United Kingdom. But electricians themselves confess to bitter disappointment with the dulness of their trade as a whole.

Nevertheless, the applications of electricity to industrial uses continue to grow. Electric lighting by the aid of gas-engines, in what are called independent installations, supplies work for many firms, the severity of whose competition with one another is notorious. Electricity is being successfully applied to hoisting, mining, and workshop machinery of many descriptions; and also in chemical industry. It is mainly the distribution of electricity from central stations that fails to bear out early promise; and, unfortunately, it is in these enterprises that the greater part of the money that has been invested in electrical ventures is sunk.

The cheapening of incandescent electric lamps which ensued upon the lapse of the Edison and Swan master patent for England rather more than a year ago, must probably have had some effect upon the electric lighting industry; but if so its character has not been remarkable. Some success has attended the revival of an old idea in electric arc lighting for mills, &c., in which the light itself is shaded off, and only allowed to be reflected from the ceiling; but the arc light is not much of a favourite in this country as an illuminant. Some discredit has also been thrown upon it as a lighthouse appliance by the failure of the light to pierce fogs; and the utility of the electric search-lights with which warships have been fitted as a means of protection against torpedo boats is gravely questioned.

Electrical distributing plant placed in channels underneath public thoroughfares gave a considerable amount of trouble in different places. At Bournemouth and in Cannon Street, London, horses were killed by electric shock; and in Glasgow and London, explosions occurred in street junction-boxes which were ascribed to leaks of electricity. At Southampton, electrical action took the course of perforating a gas service-pipe. The exigencies of the latest system of high-pressure electrical distribution led to the demand for the construction of transformer chambers under the surface of the public streets, which was resisted by the local authorities and formed the subject of a Board of Trade inquiry. Several annoying break-downs of the public and private lighting service occurred in many localities, notably in the City of London, which led the authorities of the new Tower Bridge to reject electricity for the lighting of this important structure. On the whole, therefore, it cannot be said that the year's experience goes to show that the problems of paying and reliable electrical distribution have as yet been solved.

No tangible progress was effected during the past year in improving electric lamps, or in any electrical appliance capable of rendering electric lighting cheaper. To speak by the authority of Mr. Ferranti, it would indeed appear as though those electrical industries which actually stand upon a working footing are now as well equipped in the matter of apparatus as can be hoped for from the present standpoint of science. That the high-water mark of efficiency in electrical apparatus should have been already attained by designers and mechanicians who have only been occupied in this business during a period embraced within the lifetime of a single master patent, such as that for the Edison and Swan lamp, seems, on the face of it, an almost incredible result; but it is explained by the height to which the physical science and the mechanical art of the age had reached when this new application was opened out before them. Modern science and industry and financial methods have acted upon the electrical industries like a forcing-house upon a plant, and have effected in at most fifteen years what would have been impossible of realization in a century under older conditions. So far as perfection in electrical plant refers to the quality of the dynamo, it has been attained for many years past. Electrical storeage would cheapen the supply from central stations; but there is no advance in this direction to be recorded. Relatively speaking, the claims of incandescent electric lighting to be a more economical means than gas of converting the potential energy of coal into light, have suffered deterioration in public estimation by the proofs that have been given of the superior duty realized by the incandescent gas-burner.

On the whole, therefore, and notwithstanding the circumstance of some of the best central station electric lighting undertakings having extended their operations and maintained their financial position during the past year, it cannot be truly said of the modern industrial applications of electricity, taken in their entirety, that the year's operations leave them with brighter or larger prospects for the future. Of electrical trading and scheming there is plenty; but of profit-making there is very little. Broadly speaking, if all the capital represented in new electrical enterprises set on foot during last year were entered against the capital ascertained to be lost in similar ventures the balance would be heavily on the wrong side.

The Decimal System in Turkey.—We learn from the *Chemiker Zeitung* that the decimal system of weights and measures will be adopted in Turkey at the end of next month.

Mr. Adam Robertson, the Chairman of the Alnwick Gas Company, died last Sunday week, at the age of 60 years. The cause of death was cancer, from which he had suffered for about four years.

THE LATE MR. GEORGE GARNETT.

THE funeral of Mr. George Garnett, whose death on the 18th ult. was recorded in last Tuesday's JOURNAL, took place on the following Friday amid every token of the great esteem in which deceased was held. Ryde was in mourning from end to end. Although the day was very unfavourable, there was a large assemblage of people both at the Parish Church, where the first portion of the burial service was conducted, and at the Cemetery; and it was remarked that it had been long since so much public sympathy had been shown at the funeral of a townsman. Beyond the chief mourners, representatives of the Ryde Gas Company, the Corporation, the School Board, and every public body in the Isle of Wight, were present; while several members of the South-West of England Association (of which Mr. Garnett was twice President), and other gentlemen connected with the gas industry, attended to pay their last tribute of respect to their late friend and colleague. The coffin, which was of polished English oak, with brass fittings, was conveyed on a Washington car, and was followed by 22 carriages. The floral emblems of sympathy were so numerous that they had to be conveyed separately. The day following Mr. Garnett's death, the following vote of condolence was passed by the Directors of the Ryde Gas Company: "The Directors deeply regret to record the irreparable loss they have sustained by the death of their beloved friend Mr. George Garnett, M.Inst.C.E. (Engineer, Secretary, and General Manager of the Ryde Gas-Works), who has rendered faithful, devoted, and most distinguished service to the Company for a period of thirty-six years." A copy of this resolution was forwarded to Miss Yorke, who superintended Mr. Garnett's household, with the expression of their deep sympathy with her and the other members of the family. Sympathetic and appreciative resolutions have also been passed by the head teachers under the Ryde School Board, of which, as already mentioned, Mr. Garnett was the Chairman. In all the educational institutions he took a deep interest. He had, in fact, just been engaged in looking over the Bibles and other books to be given to the school children at the breaking-up for Christmas when he was seized with the illness from which he never recovered. Beyond his connection with the Ryde Gas Company, Mr. Garnett was a Director of the Ryde Pier Company and of the Ventnor Gas and Water Company. He was also Chairman of the Shanklin Gas Company; and at a meeting of the Directors held on the 22nd ult., the following resolution was passed: "The sudden death of their esteemed Chairman fills the members of the Board with profound sorrow; and they desire to place on record their sense of the high professional ability and zeal which were always unreservedly exercised in the interests of the Company. They had the warmest appreciation of the sterling worth which distinguished their deceased friend; and they now wish to offer a sincere tribute to his memory, while expressing deep personal sympathy with his family under such grievous bereavement." Resolutions expressing their sense of the loss the town has sustained by Mr. Garnett's death were passed by other societies.

M. WITZ ON GAS AND PETROLEUM ENGINES.*

THIS book forms the second part of Professor Witz's admirable work on "Gas-Engines," the third edition of which was issued in 1892. It is in the nature of a supplementary volume; and it treats in detail petroleum motors, cheap or power gas generators (now so much used for driving large engines), and the application of gas-motors to generate electricity. An account is also added of the principal internal combustion engines which have appeared since the publication of the first volume.

The author begins with a careful review of the progress made of late years in this special branch of engineering science, more particularly in the methods employed of igniting the charge, regulating the speed, and starting a gas-engine. He notes that preference seems now generally given to hot-tube over electric ignition; but he is of opinion that engines should be so constructed that either system can be utilized at will. The usual course in governing an engine is to cut off wholly the supply of gas, instead of allowing a poor, and often un-inflammable, mixture to pass through the cylinder. Slide-valves are almost entirely abandoned; the tendency is to simplify all the organs of construction. The question of getting cheap gas has assumed far larger dimensions within the last few years, as gas-engines have increased greatly in size and power. Some companies on the Continent have seen the advantage of reducing the price of lighting gas used for power purposes, though the idea is making way very slowly in France. In Switzerland, cheap power gas and lighting gas are now made simultaneously by the same company, and supplied successively though the same mains—the power gas by day, the lighting gas at night. Many Swiss towns have adopted this arrangement. Cheap or generator gas was first made in 1862; and the gain in economy by using it in place of lighting gas for large power motors has now been placed beyond a doubt by Mr. Dowson and others.

In making a trial with any kind of gas, it is of the greatest importance to determine exactly its heating value. On this point, the author says: "The richness of any gas may vary considerably from one day, and even from one hour, to another; and gas drawn from different works is never of the same quality. Hence a gas-engine trial has neither meaning nor value, unless the number of thermal units developed per cubic foot of gas consumed is carefully measured." This may be determined either by analyzing the chemical constituents of the gas, or by testing its heating value in a specially constructed calorimeter. The latter method is the best, cheapest, and most certain. Experiments upon the calorimetric value of lighting gas have lately been made by MM. Mahler and Aguitton,* as well as by Professor Slaby, of Berlin, and on the pressure developed by the explosion of a gaseous mixture by Messrs. Lean and Bone, of Edinburgh,† M. Roszkowski, in Germany, and Professor Cawthorne Unwin, F.R.S. The author himself has carried out careful trials of cheap gas, especially of the Dowson and Lencauchez systems; and he gives his results, together with others by M. Ledebur. The Buire-Lencauchez generator is already much used in France, and has the great advantage of producing gas from poorer kinds of French coal. There are 29 places in France where it is now employed in conjunction with "Simplex" gas-engines, the makers of which (MM. Delamare-Debouteville and Malandin) have for some years taken up the construction of this generator with great success. The most important example of the kind is at Pantin (Seine), where a "Simplex" gas-engine indicating some 300-horse power, driven by Lencauchez gas, is working satisfactorily.‡ Other systems are the Gardie, Taylor, Kitson, and Bénier. Dowson gas still, however, holds the first rank among generators supplying cheap gas for motors; and both Mr. Dowson and M. Lencauchez have done much to diffuse a knowledge of the subject.

In the part of his book treating of the "Theory of Gas-engines," the author has divided his subject under two heads—first, what he calls the generic theory, based on scientific calculations; and, secondly, the experimental theory, founded on the results of experimental research. The theory of the gas-engine has recently been well set forth by M. Paul Vermand, and by M. Boulvin, the distinguished Belgian Professor of Engineering at Ghent. The latter gives special prominence, in his "Cours de Mécanique Appliqué," to the study of "entropy" diagrams, a term used by Clausius. The author is strongly opposed to those who would improve the cycle of a gas-engine by the addition of a regenerator. "The cylinder of a gas-engine," he says, "although filled with a cold charge, is so hot already that it is absolutely necessary to cool it with a circulating water-jacket. . . . It is now proposed to superheat still more the mixture admitted. What would be the result? The walls would attain so high a temperature that the piston would give trouble, the valves leak, the oil and lubricants burn, and it would not even be possible to admit explosive gas into the cylinder." A regenerator can be of use only where compression of the charge takes place in a separate cylinder; and even there the gain is somewhat doubtful.

Upon the subject of "Experimental Theory," the author is one of the first authorities; and his many and useful researches have already been published. One of the most exhaustive treatises that has lately appeared on the question of gas-engine efficiency is by Professor Slaby, of Berlin, with whom the author is at issue. In his "Calorimetrische Untersuchungen," Professor Slaby considers that the phenomena affecting the efficiency of the gas-engine may be chiefly referred to the speed; M. Witz would attribute them rather to the temperature of the cylinder walls. Another question belonging to this branch of the subject is the desirability of diluting the fresh explosive mixture in the cylinder with the products of the former charge. Mr. Dowson maintains that this greatly diminishes the efficiency of the engine; and others—notably Mr. Atkinson—are of his opinion. But the matter is still rather in doubt, and certainly requires more experiments to prove it.

The next chapter contains valuable information respecting trials of gas and oil engines, the best methods of making them, and the latest instruments invented for that purpose. Professor Witz's own experiments with the vibrations of a tuning-fork (by which the 8oooth part of a second can be measured) are well known; and this system has often been utilized by others. Mention is also made of Mr. Ransom's trials of Atkinson and Crossley motors. A valuable supplementary list of trials published since the issue of the first volume of the work is added, drawn from Mr. Bryan Donkin's book entitled "Gas, Oil, and Air Engines,"§ Minutes of the French and English Societies of Civil Engineers, the Franklin Institute, and other sources, as well as from various technical papers.

The second part of the book begins with a description of the latest types of gas and petroleum engines, classified according to their different systems. Of the original motor without compression, as first introduced by Lenoir, M. Witz has, of course, little to say. A few engines of this kind, such as the Bischopp, are still made; and one, the Lentz, has been added to the list. Their chief recommendation is their simplicity; and they are said to require no supervision. The two-cycle type is represented among modern engines by the Campbell, Ravel, Connelly, Day,

* "Traité Théorique et Pratique des Moteurs à Gaz et à Pétrole." Par Aimé Witz. Tome II. Paris: E. Bernard et Cie.; 1894.

* See JOURNAL, Vol. LXII., p. 402.
† *Ibid.*, Vol. LX., p. 595.
‡ *Ibid*, Vol. LXIV., p. 1115.
§ *Ibid.*, Vol. LXIII., p. 278.

and the Bénier motor, to which a gazogene or the production of cheap gas is attached. The special feature of this generator is that the scrubbers and gasholder of an ordinary gas-producing plant are abolished. This piston of the engine itself draws the charge of air through a layer of glowing combustible to make the gas, which is then washed, and a small quantity of steam added to it before it enters the cylinder. Thus the gas is made as wanted. This ingenious small-power gas-engine and generator combined is still, however, in the experimental stage.

It is among four-cycle engines that the greatest progress has been realized, and the largest number of new types produced. The author notes several new engines, as the double-acting Letombe, and improvements in the Niel, Charon, Fielding and Platt, &c. The "Simplex," which has long ranked among the best French motors, is well represented. Hitherto these engines, even for the largest powers, are single-cylinder. Probably the largest gas-motor yet made is a 400-horse power two-cylinder Stockport engine, driven by Dowson gas, at Messrs. Spicer's works at Godalming. The last group of engines comprises those with combustion and compression, among which M. Witz describes a two-cylinder motor made from the designs of the late M. Gardie. Like the Bénier, a gas generator is attached to it; and it has also a regenerator and a compression pump. The Vermand, another engine of a similar type, has not yet advanced beyond the stage of design.

Coming now to petroleum motors, the author describes various well-known types, as the Priestman, Hornsby-Akroyd, Capitaine, Trusty, Ragot, Griffin, &c., and a few minor novelties. A well-arranged chapter is next devoted to a consideration and discussion of the different parts of an engine—as the piston, ignition apparatus, governor, &c., and to the latest improvements effected in them. The modern tendency seems to be in favour of inertia governors placed sometimes inside the fly-wheel, rather than ball governors of the Watt type. With their increase in power, the starting of gas-engines has, of late years, become an important question, and engaged much attention. Many of the principal makers provide a self-starting arrangement; and the Pinkney and Lanchester patent apparatus is also worthy of notice.

The last part of the book is devoted to a study of the numerous uses to which gas and oil engines are applicable. For mills, fire-engines, pumping, and various mechanical industries, their value has long been recognized. The author maintains that there is no branch of manufacture to which gas-motors have not been applied. He notes their special suitability in dock-yards to generate energy for lifting cranes and other machines for emptying and loading ships and warehouses. At Liverpool, as shown by a quotation from a paper by Mr. J. Parry, gas-engines are now superseding steam for much of the work in the dockyards, which is perhaps greater in this city than in any other part of the world. As the power required is intermittent, the advantage of a motor in which it can be turned on and off at pleasure is manifest. About 700 gas-engines are now running at Liverpool.

One of the most important applications of these motors is undoubtedly to generate electricity for lighting, where the price of gas is low; and several firms now make a speciality of supplying gas-engines for driving dynamos. When electric light was first offered to the public, a conflict between the electric and gas companies was the immediate result; and it was confidently predicted that one or the other interest would be annihilated. A calmer spirit now prevails; and it has been recognized that lighting gas, if cheap enough, can be turned to very useful account by utilizing it to generate electricity. The new movement originated in North Germany; and the station at Dessau for supplying the town with electric light from dynamos driven by "Otto" engines was started in 1885.* Other towns have not been slow to follow its example. Professor Witz remarks that "if an electric plant be attached to the gas-works in a town, the gas company is able to retain customers who would be lost if it persisted in offering them gas only. The company ought to aim at providing the required products from its own resources, and thus appropriate the working profits." From a pecuniary point of view, the author is of opinion that the company will make a profit on the transaction, especially if generator gas be used instead of lighting gas to drive the dynamos. It is a well-known fact—proved, among others, by the author—that if gas be supplied to an engine for this purpose, the light produced by the electricity is greater than if the same quantity of gas were consumed in an ordinary burner. A calculation is added by M. Witz as to the price of electricity in France and England.

Another purpose to which oil and gas engines are applied is for tramways, traction engines, and pleasure-carriages on roads. The advantages of oil-engines in this respect are great, since they are able to carry with them a supply of oil for many hours; and they are also lighter than steam-engines. Gas-motors can be utilized under the same circumstances, if supplied with compressed gas in special steel bottles. These bottles will resist an internal pressure up to 900 lbs. per square inch; and there is the further advantage that the gas is delivered to the engine already compressed. Pintsch oil gas is also used. Tramways in New York, Dresden, and Neuchatel are worked by motors driven by gas, oil, or carburetted air. The author considers oil-engines as the most suitable for locomotion; and improvements are yearly made in their construction. These engines have also been successfully applied to small boats and launches, especially the Daimler, Capitaine, Peugeot, and Roger. An attempt is now being made in France to utilize them for propelling tricycles and road carriages; and the efforts of inventors were stimulated by an interesting competitive trial of "carriages without horses" held in France in July, 1894.

Of the various books on gas-engines which have appeared of late years, few will rank with Professor Witz's work in a real knowledge of his subject, both from a theoretical and practical point of view, Gas power engineers and students will profit much by reading it. The two volumes form a standard work which ought to find a place in all scientific libraries; and they present, under a compendious form, the principal data available up to the present time with regard to these engines. There are 400 pages in the volume under notice, and a large number of good illustrations. The style in which the book is issued is a great improvement upon the earlier editions. There is a bibliography of works consulted, but no complete index—a defect which will, we hope, be remedied in any future edition.

* A description of this station, by Herr W. von Oechelhaeuser, the General Director of the German Continental Gas Company, has been given in the JOURNAL (see Vol. LIX., pp. 21, 67).

THE ACCOUNTS OF THE AMALGAMATED SOCIETY OF GAS WORKERS, BRICKMAKERS, AND GENERAL LABOURERS.

WE have before us a copy of the printed and audited accounts of the income and expenditure of the above-named Society for the half year ended the 17th of June, 1894. This Society is in some respects typical of the newer form of trades combinations, representing the "New Unionism." It usually celebrates its annual meetings in Birmingham, under the presidency of one of the parlimentary leaders, and under the patronage of lesser local luminaries of that movement. Some account of its finances will consequently possess particular interest for our readers, from their special bearing on the gas industry.

The Society appears to have been founded in 1889—the year in which, it will be remembered, the eight-hour system of working was generally adopted in gas-works throughout the country; and its first report was published at the end of the year "ending December, 1890." Notwithstanding its pretentious title, the operations of the Society seem to be limited to twenty-one branches in nineteen towns having gas-works, in the counties of Derby, Gloucester, Stafford, Warwick, Worcester, and York, and two branches at the Water and Health Departments of Birmingham. This makes a total of twenty-three branches, with an income of about £900 a year; as against fourteen branches in eleven towns, with an income of £800 a year in 1890. The two branches at Bradford, and one at Keighley, appear to have seceded since 1890; and new ones have been formed at Birmingham (in the Water and Health Departments of the Corporation), Bilston, Bridgnorth, Gloucester, Kidderminster, Long Eaton, Low Moor, Oldbury, Stafford, Tipton, and West Bromwich, with a second branch at Derby.

The accounts of the Society are not very clearly stated; and it is necessary to give them in some detail, to make them intelligible. Those for each branch are set out separately, of which the following example is selected, because it incidentally illustrates the method of forming new branches:—

DERBY NO. 1 BRANCH.

Income.

	£	s.	d.
Cash in hand, Dec. 19, 1893	1	2	11½
Contributions	19	19	9
Rules and cards	0	7	5
Funeral levies	1	13	5
Total	£23	3	6½

Expenditure.

	£	s.	d.
Postage	0	2	8
Paid to reserve fund	4	6	6
Delegate and Committee expenses	3	19	6
Secretary's salary	1	13	4
Auditors and Treasurer	0	18	0
Collectors' commission	0	18	8
Funeral benefits	5	0	0
Trades Council	0	16	3
Organizing Long Eaton	2	16	1½
Cash in hand	2	12	6
Total	£23	3	6½

Turning for a moment to the accounts of the Long Eaton Branch, we find that this expenditure on organization resulted in an income there, in three months, of £1 12s. 3d., and an expenditure (including 6s. 4d. for public meeting) of 12s. 1d.

In each of the separate accounts of the branches, there is an entry—as at Derby—of an amount "paid to reserve fund;" but there is no subsequent reference in the general accounts to a reserve fund, but only to amounts paid to the bank. It will be seen, in fact, from our subsequent analysis of the accounts, that the use of this phrase is calculated to somewhat mislead the contributors to the fund, who cannot be expected to be familiar with accounts, and therefore to learn for themselves that these payments "to reserve fund," are payments only to the central organization of the Society, and have to bear the expenditure of the central organization, before any savings are paid to the accumulated fund at the bank.

The total of these separate payments said to have been made to the "reserve fund" in the half year is £258; but the actual addition in that period to the accumulated fund at the bank was, apart from interest, £90 only. The difference was represented by payments of £23 for purposes of relief—such as funeral grants, out-of-work pay, &c.—and £147 for the general expenses.

The total income from the branches, including the cash in hand at the beginning of the half year, is summarized and dealt with in the accounts as £504 os. 2½d. But, according to the total of the separate accounts, it was £504 15s. 5½d. The general accounts thus understate by 15s. 3d. the income for the half year, as it appears in the accounts of the branches. The total expenditure of the branches in the half year is summarized and dealt with in the accounts as £199 11s. 4d.; while, according to the total of the separate accounts, it was £199 4s. 6d. It was thus overstated by 6s. 6d. as it is set out in the accounts of the branches. These errors—showing a total difference of £1 1s. 9d. as between the transfer from the branch to the general accounts—are neutralized in the latter in the item "cash at branches." This is there stated to be £46 7s. 7½d.; while the total of the amounts stated in the branch accounts as cash in hand is £47 9s. 4½d.

Following the separate accounts of the branches, the general accounts of the Society are set out as follows:—

General Expenditure.

Printing	£15 18 8		
Postages and stationery	7 19 2		
Executive meetings	6 9 6		
Delegate expenses	4 19 4		
Conference meeting (Derby)	30 13 4		
Dispute pay (Stourbridge and Saltley)	7 18 0		
Auditing general and interception	1 18 0		
Trustees' expenses	0 15 0		
Trades Council and attendance	4 10 6		
Grant to Woolsorters (Bradford)	5 0 0		
Rent of school	0 15 0		
Relief to members	0 2 0		
Funeral expenses (Dudley and Coventry)	10 0 0		
Rubber stamp (Gloucester)	0 4 6		
Banner (Wolverhampton)	0 2 4		
Secretary's salary	52 0 0		
„ railway fare	8 14 1		
„ expenses	5 5 0		
Rent of office	6 10 0		
		£169 14 5	
Branch expenditure	£103 12 10		
Funeral expenses	50 0 0		
Out-of-work pay	45 18 6		
		199 11 4	
Cash at branches	£46 7 7½		
Paid to bank	130 0 0		
Cash in Treasurer's hands	52 10 0		
„ General Secretary's hands	15 7 5½		
		244 5 1	
Total		£613 10 10	

Banking Account.

Cash at bank, Dec. 19, 1893	£1191 17 1	
Deposited half year ending June 17, 1894	130 0 0	
Interest for 1893	23 6 11	
	£1345 4 0	
Withdrawn during half year	40 0 0	
Leaving total at bank	£1305 4 0	

Omitting from the accounts so stated items which appear both in the general and branch accounts, and correcting them for the errors mentioned, we have prepared from them the following general statement for the half year:—

Income.

Cash in Treasurer's hands, Dec. 19, 1893	£55 10 0	
„ Secretary's hands	14 0 7½	
Cash at bankers	36 12 3½	
		£106 2 11
Contributions	£394 10 4	
Entrance fees	12 8 1	
Rules and cards	9 17 2	
Fines	3 6 6	
Funeral levies	38 0 1	
Overcharge in last account	0 1 0	
	£458 3 2	
Less error, unaccounted for	0 15 3	
		457 7 11
		£563 10 10

Expenditure.

Management—	Branch.	General.	Total.
Secretaries	£33 0 4	£52 0 0	£85 0 4
Secretary's railway fare and expenses	—	13 19 1	13 19 1
Collectors' commissions	14 16 5½	—	14 16 5½
Check stewards	1 18 0	—	1 18 0
Auditors and Treasurers	15 4 6	1 18 0	17 2 6
Trustees' expenses	—	0 15 0	0 15 0
Delegates' expenses	11 7 0	4 19 4	16 6 4
Organizing and demonstrations	4 5 0½	—	4 5 0½
Carried forward			£154 2 9

Brought forward									£154	2 9
Committee meetings	£5	15	0	£6	9	6	12	4	6	
Conference meeting	—			30	13	4	30	13	4	
Trades Council and attendance	6	1	9	4	10	6	10	12	3	
Rent of rooms	7	3	6	7	5	0	14	8	6	
Printing, stationery, and postage	3	7	0	24	2	4	27	9	4	
Emblems and banners	0	4	0	0	2	4	0	6	4	
									£249	17 0
Relief pay—										
Dispute pay	—			7	18	0	7	18	0	
Relief to members	—			0	2	0	0	2	0	
Out-of-work pay	45	18	6	—			45	18	6	
Funeral expenses	40	0	0	10	0	0	50	0	0	
Grant to Woolsorters (Bradford)	—			5	0	0	5	0	0	
									108	18
Money refunded	0	3	9	—			—		0	3
Paid to bank				130	0	0	—			
Less withdrawn				40	0	0	—			
							—		90	0
Cash in Treasurer's hands							£52	10	0	
„ Secretary's hands							15	7	5½	
Cash at branches							46	7	7½	
									114	5 1
Add error unaccounted for									0	6 6
									£563	10 10

It is worthy of note that, of the total income of £457 for the half year, £218 was contributed by the six branches in Birmingham connected with the works of the Corporation.

There are many points of interest in these accounts which will at once occur to our readers. That a Society with an income of £460 in the half year should spend £250 of it on management expenses, would seem to be incredible but for the witness of the accounts. A glance at these accounts in detail, however, at once shows how enormously wasteful this expenditure is. The system by which payments are made to delegates from the branches, and again from the central organization to such bodies as the Trades Council, and to conference meetings, is not only an important addition to the already heavy expenditure of the Society, but would appear on the face of it to be unnecessary, as providing for a double representation of the Society on each organization.

The fact that errors, though small and unimportant—except that even trifling errors in auditing should be avoided—have crept into the accounts, shows that, instead of an expenditure of £19 on Auditors and Check Stewards, a smaller fee could be profitably paid to a competent accountant, who would not only ensure accuracy in the accounts, but would prepare them for the Society in a form which would be more intelligible to the contributors and indeed less likely to mislead them.

The direct benefits which the contributors to this fund expect to obtain from it, besides being insignificant, as compared with the expenditure in payment of an army of Secretaries, Auditors, Treasurer, Check Stewards, Delegates, and other officials, appear to be wastefully gained in other ways. The levies for funeral grants, which are the most important of them, are insufficient to provide the benefits, and would not only be more providently, but probably also more fairly, obtained through a well-managed Friendly Society. These levies appear to vary as much as from 13 per cent. on the contributions at Walsall to 3½ per cent. on those at Tipton. The indirect benefits must be still more problematical. A strong Trades Union with accumulated funds at its disposal, has often been enabled to obtain advantages for its contributors which, without its assistance, would possibly have been difficult or impossible of attainment. But this Society, which has branches in towns in which probably 4000 men are employed in gas-works alone, has at the end of five years accumulated £1300. At the end of another five years, at its present rate of progress, it will possibly have accumulated a total sum that will represent something considerably less than the amount paid in one single week as wages to the workmen in its Birmingham branches only; and it cannot, therefore, be looked upon as one that will attain to any such position of strength in the lifetime of many of its present contributors.

It was recently stated in a Birmingham newspaper that the election expenses of one of the paid officers of the Society nominated as a guardian for the parish of Aston-juxta-Birmingham would be borne by the Society. Probably this will in the future lead to a further depletion of the funds; for it is scarcely to be expected that the contributors at busy towns like Derby and Gloucester will be content to see their funds expended on elections in Birmingham, unless the contributors there are equally willing that the funds of the Society may be expended for the same purposes also at other places.

It is not, of course, for us to raise any objection to the methods of management followed in the Society. Those methods are the concern of the contributors; but if those contributors are mainly drawn from a class of workmen who are not familiar with accounts, and may be easily mistaken as to the position of any society to which they subscribe, it must be a matter for regret that there is no independent authority to whom they can periodically submit their accounts for examination. In connection with their Friendly Societies, the State has made such a provision; but this obviously is quite a different matter. Would it not, however, be possible for the central organization of the Trade Unions of the country—the older of

which have already played so useful a part in industrial organization, and who are reported to be already looking into the methods by which some of the younger Unions are said to have obtained disproportionate representation on the central body—to combine with this inquiry another? How far could they undertake to constitute a central authority to whom all such accounts should be periodically submitted for confidential examination and report? If, as a body, they were not able to check such wasteful expenditure as this, they would at least be able, and it would be their responsibility, to make it clear to contributors to these societies on what their contributions are actually expended.

COMMUNICATED ARTICLES

THE GAS-TRAMWAY AT DESSAU.

By W. von Oechelhaeuser, of Dessau.

[We are indebted to the author for an advance copy of a communication to the *Journal für Gasbeleuchtung* on the above subject; and we are thus able to present the following unabridged translation to our readers simultaneously with the publication of the original in Germany.]

The gas-tramway at Dessau commenced regular running on the 15th of November. It is 2¾ miles in length; consistiug of two sections—one 1·55 miles long, the other 1·20 miles. The track is formed with "Phœnix No. 7" grooved rails, set to a standard gauge of 4 ft. 8½ in., and has many sharp curves—one to a radius of only 40 feet. Besides several easy rises, there is one about 150 yards long, with a gradient of 1 in 30, ending in a sharp curve. The first (longer) section was opened on the above date; the second, on the 6th of December. The provisional rolling-stock is nine gas-motor cars on Lührig's system.* Under one seat of the car is a gas-engine of 7-horse power, the two cylinders of which lie horizontally opposite one another; the pistons working on a common crank axle. The engines are furnished with valve motion, and electric igniting apparatus; and they were provided by the Deutz Gas-Motor Works.

The chamber containing the motor is tightly closed beneath, and on the inside; but on the outside there are a large folding door and two small flaps giving access to it. When the doors are shut, the position of the engine is indicated only by the semicircular depression in the casing for the accommodation of the fly-wheel. From the opposite side, the car presents the appearance of an ordinary horse or electric car. The spent gases from the engine are expelled beneath, without noise. The gas used (ordinary illuminating gas, compressed) is carried by the car in three stout-walled wrought-iron reservoirs, of which the largest is beneath the seat on the opposite side of the car to the engine; the two smaller ones being placed under the body of the car before and behind the wheels. The three holders have a united capacity of 28 cubic feet; and they are filled with gas to a pressure of 6 atmospheres.

Oil gas for lighting has been carried in precisely similar fashion on railway carriages for years; and at quite as high a pressure. The holders act as reservoirs of *power* on the gas tram-cars; on the railway waggons, *light* is supplied from them. The danger of explosion, which many people fear with gas tram-cars, is no greater, as they are now constructed, than with gas-engines and gas-lit railway carriages. There are 26,000 gas-engines continually at work in Germany; and the majority of the railway carriages are provided with compressed gas. Yet an exploded gas-engine or railway carriage is unheard of. The setting on fire of a gas car at Dresden lately was traced to negligence on the part of the attendant; and the employment of an old pattern union on the hose used for filling. The cap of the connection was not in this case (as in the Dessau cars) outside the car, but inside it. Occasional fires such as this have repeatedly occurred on electric lines through the firing of the fastenings of the electro-motor, or the overheating of the resistance box used to regulate the current; but the advantages and utility of the system are not therefore called in question.

The Dessau cars carry about 66 gallons of water for cooling; and they weigh, in running order, about 6 tons, which may easily be reduced in the future. The cars seat twelve persons inside and fifteen outside; thus carrying, with the conductor, twenty-eight people. The speed can vary at will, within wide limits; but the regulations of Dessau permit a maximum of only 7½ miles per hour. A lever on the platform controls the speed. The reversing-gear lever is adjacent; and the brake-handle, with a bell indicator, is also near by. The trial trips that preceded the opening of the line showed that the cars were easily managed; and that the brake would pull up a car in 2¼ yards when running at the maximum speed. When the car is running, the engine works at the rate of 250 revolutions. During short stops, it runs free at 80 revolutions; but during long stops it is pulled up, and restarted by turning the fly-wheel—an office easily performed by the conductor.

At the terminals of each section are two compressing stations, where the gas taken from the street-mains is compressed. The stations consist of a small house, covering a space of about 15 feet by 15 feet, containing a gas-engine of approximately 8-horse power coupled directly to the gas-pump. Under a projecting roof outside the house, are two large boiler-shaped receivers for the gas (compressed to 8 atmospheres), as well as the coolers for the gas-engine. From each station a service runs to the street tram-line where the compressed gas is drawn off from a stand-pipe.

The working of the two sections takes place as follows: Three (on Sundays, four) cars are used on each section; one starting from each end every 15 minutes. The store of gas suffices for two out-and-home journeys; and then the holders are replenished by connecting up with a flexible tube to the stand-pipe. The re-filling takes about three minutes; and the cooling-water is at the same time changed if required. It is intended in future to run at intervals of 7½ minutes. The fare, collected by a recording apparatus, is 10 pfennigs (1·2d.) on each section of the line. But at the junction passengers may change from one section to the other without further payment; so that nearly 2½ miles can be traversed for the above fare.

The working results since the opening of the line have reached, and even surpassed, expectations. The performance of the system from a technical standpoint was magnificently proved on the opening days, and repeatedly on Sundays, when instead of 28 people, 50 to 60 persons crowded on each car. The prescribed speed was easily maintained; and, at times, it even reached 8½ miles per hour. One car could push up the steep rise already mentioned another car, the motor of which was not working, even when both cars were full. It is noteworthy that the first car, filled in Deutz with compressed gas at the Deutz Gas-Motor Works, after the five days' transit to Dessau ran the whole length of the line by means of the gas with which it was charged at Deutz—an eloquent testimony to the soundness of the holders and the transportability of the cars.

The economical results are so far very satisfactory. On the first opened section, over 24,000 persons were carried during the latter half of November; and since then the number of passengers has not fallen below 600 per day. The traffic on the more recently opened section has been even greater—not having yet fallen below 1000 persons per day. During the 25 days from its opening to the 10th of December, more than 40,000 persons were carried. It is clear that the new means of transit has found favour with the inhabitants of Dessau (population 42,500) and neighbourhood. The public has already expressed a wish for the extension of the gas tramway; and at a general meeting of the Company on the 19th of December, it was resolved to procure four spare cars for the better accommodation of the Sunday traffic, and to increase the capital to meet the extension. The capital for the original work (2¾ miles of line, two compressing stations, nine cars, sheds, repairing-shops, and office) amounted to 325,000 marks (about £16,000).

Since the opening many interested persons, here and abroad, have viewed the Dessau gas tramway, and convinced themselves of the great advantages of the new method of working. The German Continental Gas Company likewise have received almost daily inquiries as to the working from town authorities, private people, and editors; so that it may be expected that other towns will shortly possess gas tramways. The advantages of gas for street tramways arise almost wholly from the power,—*i.e.* the gas—not being taken up continuously during working, but being stored before beginning work and during the intervals. The cars thus resemble steam and electric-accumulator cars. But the latter have not, up to the present time, proved reliable; and steam tramcars, on account of their smoke and costly working, can have only a limited application in towns. Thus gas-cars form the only system which can be seriously taken into account for tramways—possessing the advantage that each car is complete in itself, and is during the journey quite independent of the power-station and of other cars. The gas-driven cars can run on any line without a conductor for the power being required. The overhead conductors now customary with electric tramways are not needed with gas-lines; and consequently the cost of their erection, maintenance, and depreciation is saved with the latter. There are disagreeable accompaniments with these conductors—such as the disfigurement of the streets, the interference with traffic, and with the extinction of fires, and the disturbing and damaging of the telephone services. In the last two months fires have arisen in Barmen, Bochum, Dortmund, and Belgrade through the accidental contact of the telephone wires with the conductors. Interruptions in the traffic itself owing to damaged conductors are also inherent to the electric system.

With gas-cars, there is economy both in the cost of installation and of working as far as the power station is concerned. An electric line, on which six cars each of 7-horse power are in use, would require at the central station power at least amounting to 60-horse power—meaning, as a rule, the use of steam-engines, boilers, and a high shaft. Such an installation takes up much space; needs at least two attendants; and must be kept at work as long as the cars are running. On the other hand, the gas-compressing stations take up little space, may (if necessary) be below ground, and produce neither smoke, soot, nor noise. They require the attention of only one man; and they need not be at work all day. At Dessau, for instance, each compressing-station is at work for only three hours per day; and the attendant has time available for other purposes. The 8-horse power engines at these stations could, at full work, maintain twenty cars running uninterruptedly; while the

* See JOURNAL, Vol. LXIII., p. 152.

same number with electric power would require a central station with at least 200-horse power available. As the gas-cars are independent of the central power station, a temporary breakdown at the station does not interrupt the traffic, as is frequently the case on electric lines. The independence of the gas-cars allows the running of one to cease without the others being affected; and the next car can propel one that, for any reason, has failed. With electric cars, on the other hand, all those supplied from one conductor are thrown out of work if an interruption (such as the failure of a connection) occurs on one of them. The further disadvantage of electric lines, which is specially noticeable in America—that gas and water mains are frequently damaged by deflected electric currents—is, of course, absent in gas lines.*

Finally, it may be said that the gas tramway of all systems known at the present time for mechanical traction takes a pre-eminent place as regards convenience of traffic, cheapness of installation and working, and inertness towards telephone wires and gas and water services. It affords an output for gas, large and regular throughout the year, surpassed by no technical demands. In Dessau, the consumption during the first year is expected to amount to 5,300,000 cubic feet; and probably it is in general greater in summer than in winter. The gas tramway promises to afford to the gas industry considerable support; and with it and the Welsbach light in our minds, we can enter on the New Year with great hopefulness.

STRAINS IN GASHOLDER GUIDE-FRAMING.

By F. S. Cripps, Assoc.M.Inst.C.E.

The communication from Herr M. Niemann on the above subject which appeared in the JOURNAL last week will scarcely bear comparison with his excellent article some few weeks since. Herr Niemann, in his complimentary references to my criticism and my simplification of the formulæ in his former article, is under a slight misapprehension as to what I have done. He states that I assume the formulæ in question "are right for the whole circumference of the guide-framing," on the grounds that I consider no allowance should be made for the rollers being off the guides on one half of the circle when the wind drives the holder against the opposite half, or for the elasticity of the structure. As this would be a very dangerous error, I must at once disown any such assumption, and would refer your readers to my special article on the subject which followed Herr Niemann's paper.† In that article it will be seen that, instead of adopting complicated formulæ, applying only to two-thirds or three-fourths of the circumference of guide-framing, as the case may be, as in Herr Niemann's original example, I *increased the wind pressure per square foot* by so much as would enable the easy formulæ to be used for the entire circumference, without causing the strains on the most severely-strained members to vary from that obtained by the more complicated formulæ (with the ordinary wind pressure) to any appreciable extent, although the latter may be applied only to a portion of the circumference.‡ This proceeding cleared the formulæ of unnecessary complication, and gave practically the same results. But, of course, it was all-important that the wind pressure per square foot should be increased to make up for elasticity and misfit, as was done in my formulæ.

In taking my simplification of the formulæ, and applying them to Mr. Livesey's holder, Herr Niemann has unfortunately made some errors in the calculations, by which the strains given are very considerably less than they should be.

(1) The force of "23,910 cos $\phi \times 2$ sin (360 ÷ 24)" does not equal 5470 kilos. as stated, but 10,940 kilos., when multiplied out correctly. Hence the strains which result from this force must be doubled throughout. For instance, the compression on the back flange of the standard is 78,000 kilos. (not 39,000 kilos), and the strain per square centimetre is not 557 kilos. but 1114 kilos., or instead of 3½ tons per square inch it is about double, or 7 tons per square inch. Herr Niemann has evidently forgotten, in the hurry of writing, to multiply by 2.

(2) The value of Z is given in some places as 23,910 kilos. and in others as 9780 kilos. (without any explanation as to why such a reduction is made), which, of course, affects the strains accordingly, as everything is made to depend upon Z, the strain in the diagonal ties.

(3) Herr Niemann over-estimates the sectional area of the girders, allows nothing for rivets, but assumes the full section as being effective in resisting tension. This is wrong, because, in treating the girder as a tie, the resistance of the girder in tension cannot exceed that of its weakest place—viz., its junction with the standards.

The girders are joined to the standards by eight ¾-inch rivets having a sectional area of only about 3⅛ square inches. So that the safe tension on the girder should not exceed 15 or 20 tons; whereas Herr Niemann represents it to be 65 tons. The fact is, the so-called girders are not ties but *struts*, and instead of being in tension they are in *compression*. If it were not so, the sectional area of the girders as compared with that of the rivets uniting them to the standards is absurd. As *struts*, they only require sufficient rivets to make a rigid junction with the standard; and then the full sectional area of 15 square inches is effective in resisting compression.

In this guide-framing, the horizontal members are struts, the diagonals are ties, and the standards form the flanges to a series of girders united together to form a regular polygon. If all the bracing between each pair of standards—horizontals and diagonals alike—are in tension, then the horizontal girders may be looked upon as redundant members, and therefore dispensed with altogether. But this would never do, unless the diagonals were made strong enough to act as *struts* as well as ties, as in the case of the 12 million cubic feet holder at East Greenwich, and in Cutler's patent framing.

The errors to which I have drawn attention are sufficiently serious to demand immediate correction; for at the present time the designing of gasholders is frequently entrusted to anyone. There is no check whatever. Dangerous structures, designed by the mere "copyist" and the inexperienced, may be erected, without a murmur, in populous districts. The failure of such structures might result in great loss of life. It is therefore most desirable to prevent any misuse of formulæ by inexperienced persons, or it may be the cause of another catastrophe such as that which is reported to have recently occurred in New York—viz., the wreckage of the largest gasholder in America.

Herr Niemann deserves much credit for his former article, and for his attempt to advance a step in the application of the method to more complex structures than he originally dealt with, notwithstanding the serious errors that have unfortunately crept in, in his last paper.

27, *Great George Street, S.W., Dec.* 27, 1894.

The Water-Pumping Plant at Hampton.—The members of the Institution of Junior Engineers recently paid a visit to the works of the three London Water Companies whose pumping and filtration stations are situated at Hampton. The machinery of the Southwark and Vauxhall Company includes two 900-horse power engines, which pump to the reservoir at Nunhead 400 gallons of water at each stroke. Some 16 million gallons are sent there every 24 hours. The machinery of the Grand Junction Company consists of a direct-acting single Cornish engine, a compound beam-engine, a diagonal compound engine (a novel and powerful engine by Davey), a horizontal compound engine, and a Worthington engine—the latest type of American engine for this sort of work. The West Middlesex engines are of the Worthington horizontal and vertical types.

Notices of Accidents Act, 1894.—The Board of Trade have issued a form of notice to be sent to them, under the provisions of the above-named Act, in the event of accident occurring in connection with any of the employments specified in the schedule thereto. Among these are the construction, use, working, or repair of gas-works, or other work authorized by any local or personal Act of Parliament; the construction or repair, by means of a scaffolding, of any building which exceeds 30 feet in height, and the use or working of any such building in which more than 20 persons, not being domestic servants, are employed for wages; and the use or working of traction-engines or machines operated by steam in the open air. The particulars to be furnished are the name of the employer and the nature of the employment; the date, place, and hour of the accident, and its probable cause; the name, residence, and occupation of any person killed or injured; the kind of work on which the person was employed at the time of the accident; and the nature of the injury, and if fatal. These are to be accompanied by the name, position, and address of the person sending the notice, the date of which is to be given.

Failure of a Concrete Reservoir Covering.—A case of the failure of concrete used for covering a reservoir has just come to light at Market Harborough. The reservoir in question is an underground chamber, over which is a concrete roof, with a layer of soil on the top. On a workman proceeding recently to clean it out, a portion of the roof was found to have fallen in. The Engineer to the Local Board (Mr. J. B. Everard) has consulted a Leicester analytical chemist, who says he has little doubt that the disintegration of the concrete was due to the use of furnace slag as a matrix; there being an appreciable quantity of sulphur in the slag. The water, getting into the concrete, set up a change, partly chemical and partly mechanical; and hence the collapse. The Engineer, in a letter to the Local Board, says: "I have not used this matrix before in a similar position, but it is recommended in text-books on the subject; and I should not have felt justified in using a more expensive material." Government text-books recommend the use of slag, granite, or limestone; and naturally the inhabitants of Market Harborough are exercised, considering this fact, as to why the concrete should have failed when it was made in accordance with the instructions in the Government manuals. The repairs are estimated to cost close upon £1000.

* Such cases have happened in Boston, Brooklyn, Cincinnati, San Francisco, and elsewhere. In England, similar cases have occurred—for instance, at Blackpool, Bradford, and Preston; and these have caused the Board of Trade to make stringent regulations as to the conductors of electric tram-lines.

† See JOURNAL for Oct. 30, 1894, p. 820.

‡ In the notes following my Formula I, for the value of Z, I state: "The wind pressure per square foot is taken at 32 lbs. This is *increased to 40 lbs. to allow for elasticity of the whole framing*, &c."—F. S. C.

TECHNICAL RECORD.

TEMPERATURE IN GASHOLDERS.

We have received a copy of an essay by Dr. W. Leybold on the above subject, which has already appeared in the pages of the *Journal für Gasbeleuchtung* among the papers read at the annual meeting of the German Association of Gas and Water Engineers this year. Dr. Leybold's present contribution is a fit sequel to his paper on "The Mixing and Stratification of Gases," of which an abstract translation was given in the JOURNAL some time since.* The results of his later researches, taken from the above-mentioned essay, are briefly given below.

The walls of gasholders are of iron—a substance which has a ar lower specific heat than water, and therefore changes its temperature by radiation far more rapidly. The specific heat of coal gas, as of other gases, is extremely low. A holder of 210,000 cubic feet capacity served for the observation of the exchanges of heat between the enclosed gas and surrounding bodies during the twelve months ending June, 1894. The temperature of the gas was taken by a thermometer passed through the manhole, so that the bulb was 30 inches below the crown of the holder. A thermometer was also exposed to the air near by. The readings of these thermometers were taken twice daily—viz., at 8 a.m. and 2 p.m. At eight o'clock, little difference was found between the temperatures of the gas and air, except in the extremes of heat and cold, when the gas was appreciably warmer than the air. In very few instances was the temperature in the holder below that of the atmosphere. At two o'clock, however, the same uniformity of temperature did not prevail. With the exception of a few very dull and rainy days, the temperature of the gas was always higher than that of the air; and, further, it never fell to 32° Fahr. The difference in the two temperatures was least in the winter, when radiation is deficient. In the summer, the temperature within the holder rose well above the atmospheric temperature, even though the sun was invisible. Thus, with 50° to 52° Fahr. in the open, the gas was at 97° Fahr.; while in sunny summer weather, with 88° Fahr. in the open, the gas reached 153° Fahr. The maximum temperature of the gas observed throughout the twelve months was 162° Fahr. at 1 p.m.

On some of the very cold and very hot days of the year, observations were taken hourly during the period of daylight. In the summer, the temperature of the gas was slightly below that of the air until 6 a.m., when it began to rise rapidly, and reached a far higher maximum about 1 p.m. It then fell steadily, except when its fall was hastened by dull weather supervening. In the winter, on a dull day, the gas did not fall below 32° Fahr., though the temperature of the air fell to 19° Fahr. On a bright January day, with a temperature of 5° in the open, the gas fell to 23°. In order to ascertain if the whole of the gas in the holder was at the temperatures found, the outlet and inlet were kept closed throughout a summer's day, and the changes in the volume of gas ascertained hourly by the rise or fall of the holder—the temperature of the gas and air being taken as before.

From the changes in the temperature of gas at the spot where the thermometer was inserted, the changes of volume that would occur if the temperature of the gas was uniform throughout the holder were calculated. On comparing the observed change of volume with that calculated on the assumption that the gas was of uniform temperature, it was found that the actual change was less than that required by the assumption; and therefore it was evident that the mean temperature of the gas was less variable than appeared from the thermometer. Calculating the mean temperature of the gas from the change of volume, the following are some of the figures obtained, compared with the observed temperature:—

Time	a.m. 3.0	a.m. 6.0	a.m. 8.0	a.m. 10.0	noon. 12.0	p.m. 1.0	p.m. 2.0	p.m. 5.0	p.m. 9.0
Temperature in the open	63°	61°	72°	77°	83°	84°	77°	77°	66°
Observed temperature of gas	59°	61°	86°	104°	131°	138°	113°	97°	68°
Temperature of gas calculated from its change in volume	—	60°	84°	98°	119°	123°	116°	106°	73°

The calculated temperatures differ from those observed by as much as 15° in the extreme instance. The contents of the holder appear to absorb heat more quickly than they afterwards dissipate it.

The expansion of the gas in the holders is not a negligible actor in the summer months. If it occurs in the same degree in large as in small holders, the East Greenwich holder, with 8½ million cubic feet of gas within it, would have its contents expanded to more than 9½ millions. High temperature in the holder induces stratification of the gas. Gas having a specific gravity of ·45 at 59° Fahr. would at 149° Fahr. be of only ·38 specific gravity. If to this hot gas fresh gas at 54° to 66° Fahr. enters, it forms a layer at the bottom of the holder; and if the holder is delivering, it will be removed without having mixed with the upper strata. To further investigate this matter, the temperature in the inlet and outlet pipes was observed throughout one year. The results for each month are given in the following table:—

Month	Temperature in Inlet Main. Deg. Fahr.	Temperature in Outlet Main. Deg. Fahr.
July	64·4	57·2
August	66·2	56·3
September	63·6	55·4
October	60·8	53·6
November	53·6	50·0
December	57·2	48·2
January	59·0	48·2
February	57·2	48·2
March	53·6	47·3
April	55·4	50·9
May	57·2	51·8
June	59·0	53·6

From this it is evident that only in the hottest weather, when the temperature taken in the holder was 140° to 160° Fahr., did the gas pass out at so high a temperature as 57° Fahr.; and, on the other hand, in the depth of winter the outgoing gas was not lower than 47° Fahr., which was practically the temperature of the water at the bottom of the tank. The temperature of the water there fluctuated very little; being 47·3° in the winter and 49·1° in June. On the surface and near the outer rim, it was higher in summer. It may be pointed out that the temperature of the holder itself varies from 14° to 160° Fahr.; and that consequently the iron plates are subject to far greater expansion and contraction than the temperature of the atmosphere would really indicate.

THE HYGIENICS OF LIGHTING.

Writing lately in the *Zeitschrift für Beleuchtungswesen*, Herr W. Geutsch considers that the well-being of man is influenced in two totally different ways by the present systems of artificial lighting—first, by their direct effects on the organs of vision; and, secondly, by their indirect effects on the human organism through deterioration of the atmosphere. The degree of pollution of the atmosphere is measured by the amount of carbonic acid and carbonic oxide it contains, and also (since only a portion of the heat developed is converted into light) by the temperature thereof. The units of heat generated in the production of a light of 17 candles, according to various observers, are for 1-candle power as follows: By gas in a fishtail or batswing burner, 50; by gas in an Argand burner, 44; by petroleum, 37; by gas in a Siemens regenerative burner, 23; by gas in a Welsbach incandescent burner, 10·6; by electricity in an Edison incandescent lamp, 2·7; and by stearine candles, 92. The arc lamp develops practically no heat; but regard must be had to the changing positions of the carbon points, and the flickering, dying out, and sudden resuscitation of the light, which are all detrimental to the eyes. The desirable tranquillity of a light is nearly secured by various regulating devices in ordinary gas-burners, and is perfectly attained by the incandescent gas-light. With this there is only the gradual deterioration of the mantle, the rate of which varies very considerably. Thus, Herr W. von Oechelhaeuser found the light of one specimen diminish 29 per cent. in 524 burning hours, and that of another 65 per cent. in 583 hours. The incandescent electric lamp shows a similar diminution in intensity, which, with the deposition of carbon on the globe, causes a decrease of 50 per cent. in the lighting power of the lamp during its life. Habit rules the choice of colour in artificial lights; and it is sufficient explanation of the objections raised by some to the Welsbach light, in which the blue and green tones predominate. Recently it has been found possible to give the light any desired colour.

In estimating the deterioration of the atmosphere by the amount of carbonic acid it contains, 1 per cent. is commonly somewhat arbitrarily taken as the highest limit. In one hour, a human being furnishes 679 grains of carbonic acid; a stearine candle, 432 grains; a petroleum lamp, 262 grains per candle power; a 17-candle gas-flame, 194 grains per candle power; and the incandescent gas-light, 82 grains per candle power. The electric light does not vitiate the air by an accumulation of carbonic acid; but this vitiation is only noticeable with other lighting means when no ventilation is provided in a room. The heat of the carbonic acid produced in most systems of lighting forms an important factor in facilitating ventilation by ordinary methods.

Attempts to eliminate carbonic oxide from illuminating gas have not up to the present time found any practical application; and consequently this impurity proceeding from leaks, as well as that produced by imperfect combustion in the flame itself, must be considered. Ordinary coal gas has fortunately only 10 per cent. of carbonic oxide; oil gas, 17 per cent.; peat gas, 20 per cent.; and wood gas, 30 per cent, Carbonic oxide is not a cumulative poison; and therefore its toxic action depends solely upon the actual percentage of it in the air inhaled. Gruber found that air containing 0·5 per cent. of carbonic oxide was apparently not detrimental to men and beasts; but 0·7 per cent. caused trouble, and 4 per cent. rapidly brought on death. Carbonic oxide in the air to the extent of 0·02 per cent. is certainly quite harmless; and therefore M. Gréhant's objection to the Welsbach light, which he found contaminated the air with only 1-50th of this amount, falls completely to the ground from the hygienic point of view.

* See Vol. LXI., p. 1156.

REGISTER OF PATENTS.

Manufacture of Gas for Heating and Illumination.—Wanklyn, J. A., and Cooper, W. J., of New Malden, Surrey. No. 20,215; Oct. 26, 1893.

The patentees do not give any illustration with their specification, which is as follows:—

"In carrying out our invention, we make an artificial material the equivalent of ordinary cannel coal, by bringing wood charcoal into contact with American petroleum, or Russian kerosene, or crude Russian petroleum, or astatki, or other like suitable mineral oils from other countries, or other cheap carbonaceous liquids, including gas tar. The kind of charcoal which we find may be used with advantage is that which has been produced by carbonizing wood—such as ordinary pine or other ordinary woods—at almost the lowest temperature at which the carbonization can be effected. We immerse the charcoal so prepared in the mineral oil intended to be absorbed, and find that such charcoal is capable of absorbing the mineral oils with great ease, and in very large proportions—in some cases as much oil as is equivalent to three times the weight of the absorbing material is taken up. Having made the artificial cannel, we employ it for the production of gas for heating and illumination. This we do by heating it in a separate gas-retort, in the same manner as ordinary cannel is treated in gas-works. We find it advantageous, however (owing to the fragile character of our artificial cannel, which will not bear rough handling), to place it in any convenient iron receptacle, such as a length of stove-piping. The iron receptacle charged with the artificial cannel is then put into the gas-retort, and then subjected to the usual heating process; and gas of the required character is thereby produced in the well-known manner. Afterwards, the iron receptacle which now holds residual charcoal is drawn out of the retort; cooled in the well-known manner; and then mineral oil of the required character is poured upon the residual charcoal, which absorbs it. Or the residual charcoal is immersed in the oil; and thus, by repeating the operations above described, a cannel suitable for employment for gas making is produced, in a very economical and efficient manner, as before. Instead of an iron receptacle, it may in some cases be advantageous to use a receptacle made of the compact charcoal obtained by heating wood to a very high temperature; or receptacles made of other refractory materials may be used. Properly prepared charcoal may be used very many times in repeated operations such as are above described. It takes up mineral oil, evolves gas in the gas-retort, and will then again absorb a fresh supply of mineral oil, and so reproduce the artificial cannel."

Manufacturing Oil Gas.—Herring, W. R., of Huddersfield. No. 23,433; Dec. 5, 1893.

This invention relates to "an improved method of, and apparatus for, producing a permanent oil gas of high illuminating quality by the destructive distillation of crude mineral oils, coal tar, or other liquid hydrocarbons." It is based on the fact that the degree of heat suitable for the operation depends upon the specific gravity of the oil, and that the specific gravity of the oil increases as the distillation progresses, so that the heat which is suitable at the commencement of the distillation is insufficient for the continuance of the distillation through its subsequent stages. The invention consequently consists in "a methodical and systematic subjection of the liquid hydrocarbon to a progressively increasing heat as it flows through the retort or series of retorts; so that, as the specific gravity of the oil increases, so will the temperature at which the distillation is continued and completed."

Fig. 1

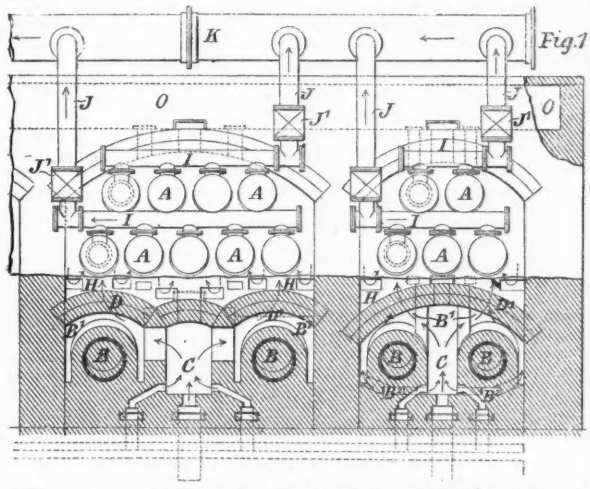


Fig. 1 represents a front elevation (partly in section) of two arrangements—differing only in the number of the upper retorts, and in the structural details consequent on the greater width of the bench. Fig. 2 is a vertical section of fig. 1. Fig. 3 is a part elevation of the back of the retort-bench.

A are the upper, and B the lower retorts he former being inclined downward from front to back, and the latter inclined downward from back to front. The retorts B are placed at either side of a combustion chamber C, and beneath an arch D separating the heating-flues of the lower from those of the upper retorts. They are surrounded with fire-brick, in order to protect them from the direct action of the furnace gases, and, by storing up heat, to maintain them at a uniform temperature. The chamber C is supplied with producer gas from a main-flue E, leading from a gas-producer, and communicating with a flue under the control of a damper, which is shown in the closed position, but is normally open—the gas entering the chamber C through apertures in the floor. The chamber is also supplied with hot air from a flue F, communicating with similar flues at either side, under the control of dampers, which are also normally open. The air enters the chamber C through apertures in the side walls, directly opposite the gas-inlet apertures, in order to ensure immediate and perfect combustion of the gases.

Fig. 3

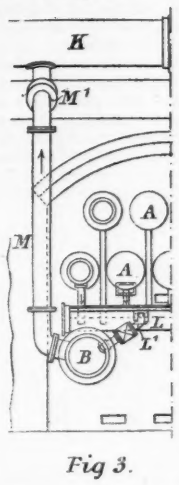
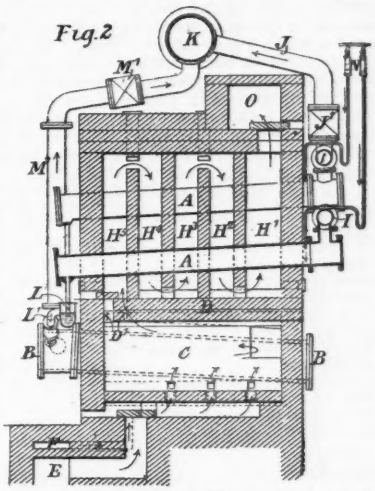


Fig. 2



The combustion chamber communicates by side apertures at the front end with the flues B^1, in which the retorts B are placed; and these flues communicate at the opposite end, by apertures D^1 in the arch D, with the flues H above. The gases of combustion flow along the flues from the lower to the higher end of the retorts B, and thence into the flues H, by which the upper retorts are heated. An aperture is also provided in the part of the arch D which forms the top of the chamber C. This is normally closed by a damper; but it may be opened more or less when required, to allow of part of the gases of combustion passing direct from the chamber C into the flues H, without passing through B^1. B^2 are additional flues, which may (if required) be formed in the brickwork beneath the retorts B—communicating at one end with the chamber C, and at the other with the flues B^1.

The retorts A are set in transverse walls, which divide the heating chamber above the arch D into a series of zig-zag flues H, through which the gases of combustion pass in the direction shown by the arrows to the outlet-flue O. The draught is regulated by a damper, which is normally open; the temperature in each part of the flue H, and consequently in each section of the retorts A, being further controlled (if necessary) by the admission of cold air to successive portions of the flues independently. The retorts A are arranged in two or more tiers; those of each tier being connected at their front or higher ends with a cross collecting-pipe I, which is in turn connected with a condensing-main K, by an ascension-pipe J, provided with a stop-valve J^1. From the lower ends of the retorts A, dip-pipes descend into a hydraulic main or trough L common to both tiers of retorts. This receives the undecomposed oil therefrom; and it thence overflows through the pipe L^1 into the upper end of one or other of the retorts B. A valve is provided for the purpose of closing the communication with the retort which is, for the time being, not in operation. The retorts B communicate at their upper ends with ascension-pipes M, provided with stop-valves M^1, and leading into the underside of the overhead condensing-main K. Thus any oil condensed in the latter will flow back to the retorts B, and be again subjected to distillation, along with the oil coming from the retorts A.

The oil is fed to each of the retorts A, preferably through a syphon-pipe supplied from a sight-feed glass N; the syphon entering the retort near the upper end, and discharging the oil into a semi-cylindrical sheet-iron scoop or tray (not shown), forming a removable liner for the lower side of the retort. This scoop extends nearly the whole length of the retort; and it has for its object to receive any carbon deposited in the retort, and enable it to be readily withdrawn—a scoop or liner being placed in each of the retorts, both of the upper and lower series A and B. As the oil flows down the retorts A, it passes through successive regions of progressively increasing temperatures (these regions corresponding to the successive portions of the zig-zag flue H); the gases distilled off passing in the opposite direction. Any imperfectly gasified vapours are converted into permanent gas in passing through the next lower heat-zone of the retorts. The oil remaining undistilled in the retorts A passes thence, through the hydraulic main L, to the lower retorts B, where it is again subjected to distillation at progressively higher degrees of temperature, until the whole of the oil is distilled and converted into permanent gas (which passes off) and carbon, which latter deposits in the scoop or liner of the retort.

No purification of the gas is needed unless the oil distilled contains impurities, such as compounds of sulphur. The carbon deposited in the retorts is said to be very small in comparison with that resulting from the methods heretofore practised; being not more than about one-fifth of that produced by the best-known methods. This result the patentee ascribes to the fact that the gasification of the oil is effected in a single and practically continuous operation, by means of apparatus wherein the oil is subjected to fractional distillation at different temperatures, which increase in a methodical and progressive manner proportionately to the increase of the specific gravity of the oil as the distillation proceeds; no more oil being introduced than can be wholly gasified in one continuous operation, and no washing of the gas with the oil, or contact with oil-saturated surfaces, and the consequent absorption by the oil of valuable constituents of the gas, being permitted.

The patentee concludes his specification in these words: "I am aware that it has been proposed to distil or crack and gasify hydrocarbon oils

and the like, by subjecting the same to distillation at one temperature, and the deposited products of fractional condensation to redistillation at different temperatures, corresponding to their specific gravities; but this method involves waste of heat, and consequently of fuel, by the alternate distillation and condensation of the oil. No adequate means existed of regulating the temperature of the retorts, according to the specific gravity of the products of the first distillation of the oil; whereas, by the arrangement of the flues, dampers, and cold-air inlets here described, I am enabled to obtain the most complete control of the operation in both sets of retorts and to maintain in the same retorts well-defined regions of progressively varying temperature, corresponding to the specific gravity of the oil in the different stages of distillation. I will proceed to give an example of the actual results, as regards control of temperature, obtained in apparatus as fig. 2; the grades of temperature indicated in the appended tabular statement being those suited to successive stages in the continuous fractional distillation of an oil having an initial specific gravity of from ·870° to ·880°."

Temperature of retorts A at point where oil enters	from	300°	to 400°	Fahr.
Temperature of that section of retorts A which lies in flue H^1	"	450°	" 500°	"
Temperature of that section of retorts A which lies in flue H^2	"	600°	" 650°	"
Temperature of that section of retorts A which lies in flue H^3	"	800°	" 900°	"
Temperature of that section of retorts A which lies in flue H^4	"	1000°	" 1100°	"
Temperature of that section of retorts A which lies in flue H^5	"	1200°	" 1300°	"
Temperature in upper end of retort B	"	1400°	" 1600°	"
Temperature in lower end of retort B	"	1600°	" 1750°	"

Street-Lamps.—Loftus, A. J., and Rowlands, E., of Birmingham. No. 24,261; Dec. 16, 1893.

This invention is intended more particularly for application to street-lamps; but it is also applicable to other lamps of like character—that is to say, to lanterns of rectangular or polygonal form.

The proposal is to place in each pane (or some of them) a glass meniscus, the inner or concave surface of which is of such curve as to reflect as much as possible of the light which does not pass through it, back in parallel or nearly parallel rays, and send such reflected rays through and out the opposite side of the lantern in a useful beam of light. In this way, an observer standing at a distance from the lamp would see not only the flame, but behind it a reflection in the concave surface of the glass, which would appear filled by the magnified image of the flame.

To insure the most perfect curve for the concave surface of the meniscus, the inventors propose to make it of the curve (or one of the curves) described in patents No. 20,023 of 1889 and No. 14,034 of 1891. These transparent reflectors, which reflect only so much of the light as does not pass through them—thus utilizing a large portion of the light which with ordinary lanterns is wasted, or nearly so—may be inserted into the panes by means of the ordinary window lead commonly used for such purposes, or the plain sheet of glass may itself be moulded or stamped while hot into the shape required. The outer surface of the meniscus may be either parallel to the inner surface or otherwise, according as it is desired to bend the rays passing through, or not to bend them. The panes forming the sides may be either vertical or inclined inwards or outwards, according to the direction in which it is desired to project the principal illumination; and the optical axis of the meniscus should correspond with this direction.

In some cases, it would be arranged to surmount the lamp with a glass globe or other dome or figure, which, being illuminated by the flame in the lantern below, would increase the illumination; and a specially constructed burner would be used for these lamps, whereby two flat flames are combined at right angles to, and intersecting each other in the centre, so as to expose a flat surface towards each pane.

Gas-Engines.—Hamilton, J. H., of Sandiacre, Derby. No. 24,384; Dec. 19, 1893.

In the specification of patent No. 6015 of 1893, there is described by the present inventor a form of engine having a four-stroke cycle, and in which the products of combustion are expelled from the combustion chamber by a charge of air. His present improvements embody the application of this principle to an engine of the four-stroke type, but having two or more motor cylinders. It also relates to improvements in valve and governor gear for this and other types of engine.

The patentee proposes to place the two motor cylinders tandem-wise—the air-cylinder in front of one of them. The front motor piston has an enlarged end to fit this air-cylinder (which also forms a guide for the front end of the piston); the size of the piston being sufficient to allow of two side-rods being attached to it. These rods pass backwards through bushes in the cover of the annular space, and alongside the front motor cylinder; being attached by their back ends to a cross-head on the back motor piston. Sufficient space is allowed between the cylinders to permit of the reciprocation of this crosshead, which is preferably provided with guiding slippers that work on planed ways on the bottom stay-piece, which connects the front and back motor cylinders. The top stay-piece is removable, so as to allow of the back motor piston being taken out; and it forms a portion of the passage for conducting the air scavenging charge to the back motor cylinder.

The arrangement for distributing the scavenging air, when the valve-gear of the motor cylinders is arranged so that an explosion shall take place each at alternate revolutions (thus giving an explosion at each forward stroke when working full power), consists of a large air or guide cylinder with two ports—one at the back end, and communicating directly with the air-passage which conveys the air to the admission-valves of both cylinders. These valves are preferably placed above the combustion chambers of the cylinders; the exhaust-valves being below. The other port in the air-cylinder is placed further along, so as to be covered and uncovered by the piston, which is of sufficient length to keep the port covered when it is full-back. This port communicates directly with the air supply from the atmosphere; but the other port only communicates with the air supply through an automatic inlet-valve.

The action is as follows: At the commencement of an outstroke, air is drawn into one of the motor cylinders, and into the air-cylinder, through the back port and the automatic inlet-valve. When the piston of the air-cylinder uncovers the front port, the air passes directly into this cylinder through that port, but still through the automatic inlet-valve to the motor cylinder. On the return stroke, which is the exhaust stroke of the other motor cylinder, part of the air drawn into the air-cylinder is first discharged through the front port—thus passing back to the atmosphere; and when the piston closes this port, the remaining air is slightly compressed, and forced through the back port into, and through, the combustion chamber of the motor cylinder, which is making its exhaust stroke, and thus expels the products of combustion and replaces them. The same action takes place during the next revolution; but the operations are reversed in the two motor cylinders—that is, the series of operations which have taken place in the front motor cylinder now take place in the back, and *vice versâ*.

The admission and gas valves are arranged as described in patent No. 4189 of 1892; and the charge of gas may either be reduced or cut off altogether, by varying the lift of the admission-valve. This admission-valve may be operated by a steel push-piece, engaging with notches in a plate attached to a lever; the lever being moved by a cam on the lay shaft, as usual. If the notches in the plate gradually increase in depth, the lift of the gas-valve will be varied to the same extent; and if a deep notch be formed at each end of the plate, the gas-valve will not be lifted when the push-piece engages with these.

The push-pieces may be pivoted to the levers which open the valves, or to the valves, and have jointed to them the ends of a rod or lever, to the middle of which the governor is connected. Thus if the governor rises or falls, and one of the push-pieces is engaged with the notched plate and the other free, the joint of the former, with one end of the rod or lever, becomes a fixed fulcrum; and the governor, acting at the centre of this rod or lever, moves the free end, carrying with it the push-piece, and thus admitting, cutting out, or varying the gas charge.

A pair of stops for each push-piece prevent them from going too far either way. These are formed on a weighted lever (or on two levers, which move together, being rigidly connected); and the stops for each push-piece may take the form of slots in the levers, through which the rod or lever described above passes. These rigidly-connected stop-levers may be counterweighted, and the counterweight supported on a fixed stop, so that, when the governor falls, the rod comes first to the end of the slots, and, when the governor speed has decreased considerably, the counterweights are raised, and the governor drops to its lowest position, in which position the push-pieces are opposite deep notches in the notched plates, and the gas-valve is not opened. This forms a safety appliance for stopping the engine should the governor driving-gear break, but will not come into action with any ordinary fall in speed due to an increased load.

The principle of this governor-gear is applicable also to four-cylinder engines, or to engines having four admission-valves. For this purpose each pair of valves may have their push-pieces connected to the ends of levers, as above described ("secondary levers"); the governor being connected to the middle of them, but in this case not directly but through the intervention of another "primary lever," and to the middle of which the governor is connected, and which in turn has each end connected—either directly or through crank-arms and spindles—to the middle of each of the secondary levers. If three of these push-pieces be engaged with notches, and the fourth free, one of the secondary levers will become fixed, and one end of the other, the other end being free; and the end of the primary lever which is connected to the former will be fixed, and that connected to the latter free. Thus if the governor rises, the free push-piece will be moved the extent of the motion; being four times the motion of the centre of the primary lever.

For operating the igniting-valve, the same lever is used as that which operates the admission-valve. The igniting-valve may be connected to this lever by a rod sliding through a nut or eye-piece on the lever, and having a spring interposed between the nut and the ignition-valve, and a stop on the other side of the nut. When the admission-valve is opened, this spring is compressed—pressing the ignition-valve on its seat. It remains closed till the lever moves back sufficiently far to bring the nut or eye-piece against the stop on the rod; and any further back movement then allows the ignition-valve to open, under the action of another spring which is weaker than the first one. Thus the admission-valve may be opened by a forward movement of the lever; and the ignition-valve, by a backward movement.

When it is necessary to alter the time of opening of the ignition-valve without affecting the other valves, the cam which operates the lever is formed, as described above, in two parts, divided by a plane at right angles to the axis of the shaft which carries it; and the roller which runs on this cam is made wide enough to bear on both parts. The one part is made of the right contour for giving motion to the admission-valve; and the other, of that required for the ignition-valve. The former is secured to the shaft, and the latter may be clamped to it by screws, so as to have sufficient angular adjustment.

Gas-Engines.—Campbell, H., of Halifax. No. 24,666; Dec. 22, 1893.

This invention has reference to gas-engines of the "Otto" type; the improvements consisting (1) in a new arrangement of inlet and exhaust valve; (2) the system of governing the engine; (3) the use of a valve and an arrangement of lever, for timing or regulating the ignition or explosion of combustible mixture in the cylinder of the engine; and (4) in the use of a hand-pump, for forcing to the engine cylinder a supply of combustible mixture with which to start the engine from rest, either with or without any load upon it.

1. The inlet and exhaust valves of the engine are placed close together, and at one end of the cylinder. The gas passes through a suitable opening to an annular chamber around the jacket of the inlet-valve; openings being made to form communications between the annular chamber and the seating of the valve, which is preferably of the mushroom type. The valve is opened by the pressure of the atmosphere each time the movement of the piston creates a partial vacuum in the cylinder; a spiral spring being used to close it. The gaseous mixture, on being admitted, passes through the perforations to the cylinder; and at the same time atmospheric air passes to the

cylinder through the main opening of the valve. But when the latter is closed, the admission of both air and gas is shut off. The piston of the engine compresses the air and gases within the compression chamber when the combustible mixture is ignited on the return stroke of the piston, and during the time the crank is turning over the dead-centre. The ignition of the combustible mixture takes place by contact with the ignition-tube. After the mixture has performed its function in the cylinder of the engine, which takes place during the outstroke of the piston, the spent mixture is exhausted to the atmosphere through the exhaust-valve, opened by a constantly reciprocating-rod receiving its motion from a cam or eccentric driven at half the speed of the crank-shaft—the reduced speed being obtained by the use of spur or other wheels.

2. When the engine overruns the normal speed, a centrifugal governor causes a lever to drop into position, so as to hold the exhaust-valve open a little while. This prevents a vacuum being formed in the cylinder; nor is the inlet-valve opened for the admission of a fresh supply of air and gas. The exhaust-valve being thus kept open by the lever actuated from the governors, the products of combustion and air are drawn alternately into the cylinder and expelled therefrom by the action of the piston; and this goes on until the speed of the engine falls to the normal, when the action of the governor will remove the holding lever, and permit the inlet-valve to act. The reciprocating-rod which opens the exhaust-valve during each forward stroke, always advances far enough to act upon the lever of the exhaust-valve; and this releases the pressure on the holding lever from the governor, so that it may be free to move upward when the governors demand it.

3. The means employed for timing the explosion of the combustible mixture consist of a valve in the end of the cylinder near the ignition-tube, which is opened at a given time by means of a lever operated by an eccentric or cam, so as to obtain the best results from the explosion. A spiral spring operates the valve in the opposite direction.

4. A pump is employed for forcing a supply of combustible mixture to the engine for the purpose of starting it, instead of moving the fly-wheel by manual labour. The pump forces the atmospheric air and gas into the compression chamber, which, on being ignited, explodes so as to give the first impetus to the fly-wheel. Afterwards the supply of combustible mixture follows on in the ordinary manner.

Coin-Freed Gas-Meters.—Glover, R. T. and J. G., of Clerkenwell. No. 674; Jan. 11, 1894.

This invention, connected with coin-freed apparatus for the sale of gas in fixed quantities, consists of a notched plate fixed to a shaft above a stationary shield, into a given notch of which plate a coin can be placed through a slot of a moveable bar to rest upon the shield, so as to thereby enable the notched plate to be rotated, for raising a valve a proportionate distance from its seating, and allow the passage of a given quantity of gas from the meter to the service-pipe. The valve is in direct gear with a screw-traveller, operated by the meter mechanism consequent upon the passage of gas, which operates the mechanism and screw-traveller to gradually return the valve upon its seating, without the intervention of any connecting levers.

Fig 1

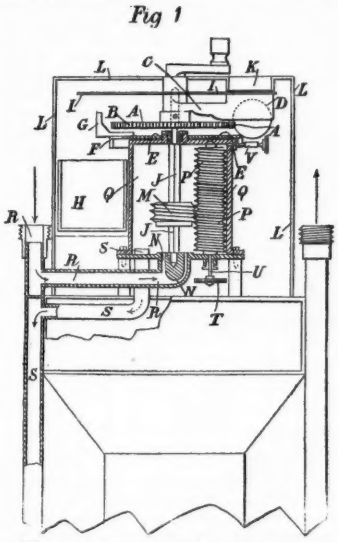


Fig. 2.

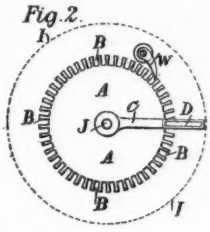


Fig 3

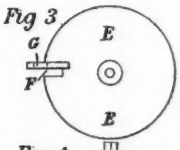


Fig. 4.

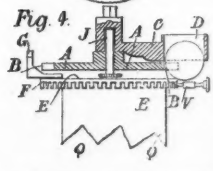


Fig. 1 is a sectional elevation of the coin-freed apparatus attached to the top of an ordinary dry gas-meter. Fig. 2 is a plan view of the notched plate and moveable money-bar. Fig. 3 is a plan of the shield, showing the coin-escape slot and stop. Fig. 4 is a sectional view of the notched plate and adjustable table.

The patentees propose to form the plate A with a number of notches, recesses, or divisions B, equally divided and disposed around its circumference, and which, in conjunction with the moveable money-bar C, its tube D, and the shield or table E, can (with its escape slot and stop F and G), after the insertion of a coin of given value and size, be rotated by a handle a given distance—adjustable by turning the table E to move the escape slot and stop F and G a further distance from, or nearer to, the starting point of the money-tube D. This varies the circumferential distance the coin will travel before it falls by its own weight through the slot F into the till H.

The handle, moveable bar, and tube, together with the shutter-plate I, which closes the penny slot, are loosely mounted upon the top end of a square shaft J, so that they can, when there is no coin inserted, be turned about freely, without affecting any of the other parts of the mechanism.

Upon the insertion of a coin through the slot K in the meter-case L, it will, if the handle be moved to its right position to bring the money-tube D immediately under the slot, fall into the tube D and one of the notches B of the plate A, and rest upon the edge of the table E, as shown in fig. 1; the coin being partly in the tube D, and partly in one of the notches B of the plate A. The handle, tube D, and plate A thus become locked, and move together when turned; and as the plate A is fixed to the shaft J, it follows that this will also turn.

This turning movement, which is limited by the tube D making contact with the stop G, causes the screw-collar M (that acts as a valve to close the gas-opening N) to lift a distance proportionate to the amount prepaid, by reason of its thread engaging with the threads of the stationary screw-traveller P, and so allow of the entry of gas from the main to the closed chamber Q, by the way of the pipe R and orifice N. The gas then passes down the pipe S into the meter bellows, which operates the registering mechanism. Any gear may be employed in connection with the registering mechanism—such as a worm that, gearing into the wheel T secured to the reduced end U of the traveller P, will rotate it for its thread to gear into the stationary valve-thread M, as in a rack, so as to gradually return the valve upon its seating, and cut off the supply of gas. The gears are so calculated that a certain number of revolutions of the registering and connected mechanism is required to allow of a quantity of gas proportionate to the amount prepaid to pass through, before the valve is closed upon its seating.

The table E is preferably slotted as fig. 4, and is secured in a given position by a set-screw V. Each division is marked preferably from 1 to 50; so that the attendant can set this table to deliver the number of cubic feet of gas it may be determined to supply for a given coin, by adjusting the table and inserting the screw in the slot designated by the number corresponding to the amount to be supplied. To prevent any back-turning of the plate A, a spring pawl W engages the notches B, so that the plate can only move in one direction.

It will thus be seen that the penny is made the means for actuating the plate by its lodgment in one of the circumferential notches; and it is prevented from falling out by its weight being borne by the adjustable table, upon the edge of which it rides until it reaches the escape-slot F, and falls by gravity into the till H.

Treatment of Tar, and Obtaining Useful Products therefrom.—Stringfellow, J. H. W., of Broad Street House, London. No. 736; Jan. 12, 1894.

In carrying out this invention, which consists in "a method of treating tar without the use of stills, to obtain useful products and compounds therefrom," the patentee proposes to proceed as follows: The tar (say, one ton weight) to be treated is put into a suitable vessel, and a small quantity—about 1 per cent. of the weight of the tar—of an alkali, such as anhydrous soda, or other matter suitable for predisposing the tar to mix with water, and quillaia saponaria, to the extent of about 0·022 per cent., is added, and the compound well mixed with one ton of water, added gradually. After this mixing has taken place, and before the water has time to separate from the tar, about one-fifth of a ton of petroleum oil, of a specific gravity of about ·820, is added, and slowly stirred into the tarry compound, until the free oil becomes of a reddish colour. It will then be found that a change has taken place, resulting in the temporary combination of all the ingredients, but succeeded almost immediately by separation into three parts: (1) A red coloured oily extract of light gravity, not miscible in water; (2) a body of soft unctuous pitch, containing a percentage of water, and approximating to Stockholm pitch in feel and general characteristics; and (3) a body of discoloured free water.

While the separating action is progressing, the red oily extract and the water can be drawn from the vessel, so as to promote the exudation from the pitch, which remains in the vessel. After a certain point of separation has been attained, the exudation of oil from the pitch proceeds very slowly; and, moreover, the last oily extract appears to be of a heavier character, somewhat corresponding to the stages of fractional distillation. Therefore it is desirable, says the inventor, after the stage of rapid separation has terminated, to draw off the fluid, and then again, after the slow stage is finished, to draw off the remaining liquid, and remove the pitch to a press, to express as much free oil or water remaining in mechanical suspension as may be desired. Or the pitch may be removed to a press directly the slow stage of separation has been reached. If the compound of tar, water, and oil is taken directly after mixing, and before separation has begun, it may be thoroughly mixed with an earthy matter, consisting of 1 ton of dried powdered clay and 4 cwt. of dry powdered lime, to form an asphalt corresponding approximately to the natural asphalt used for paving and other purposes. The solid residuum may also be pressed into blocks and used as fuel, for gas making, or for firing, and other purposes. As these solid compounds contain all the benzol and naphtha of the tar, a proportion of the volatile matters may, if desired, be driven off by heat in a suitable vessel before the compound is used as asphalt.

Manufacture of Gas from Mineral Oils.—Galletly, J., and Armour, H., of Edinburgh. No. 1490; Jan. 23, 1894.

According to this invention for the manufacture of gas from mineral oils, "the operation is carried on in a nearly continuous manner, so that large quantities of gas may be made with comparatively few retorts, and with economy both in labour and in plant."

Fig. 1 [see next page] is a longitudinal vertical section of the apparatus. Figs. 2 and 3 are vertical sections of the scrapers at right angles to fig. 1. Fig. 4 is a plan showing the position of the scrapers in contact with the retort.

A horizontal cylindrical metal retort A is slowly revolved round the shaft B. The shaft, which also revolves, passes through the retort, resting on the plummer blocks. Both retort and shaft require to be turned slowly; and this may be done by ratchet-wheels W fixed on the end of the retort and on the shaft. A frame moving horizontally backward and forward, arranged above these wheels, turns the retort while moving in one direction, and the shaft while moving the opposite way. The portion of the shaft inside the retort is square, and the rest is circular. In order to remove the carbon deposited on the inner surface of the retort, scrapers F are arranged along the square portion of the

shaft, which are turned round by it, and serve the purpose of a spiral screw. These, besides scraping off the carbon or coke as it is formed, push it along to one end of the retort. They may have two arms with scraping-plates, as C in fig. 2, or only one arm and scraping-plate, as in

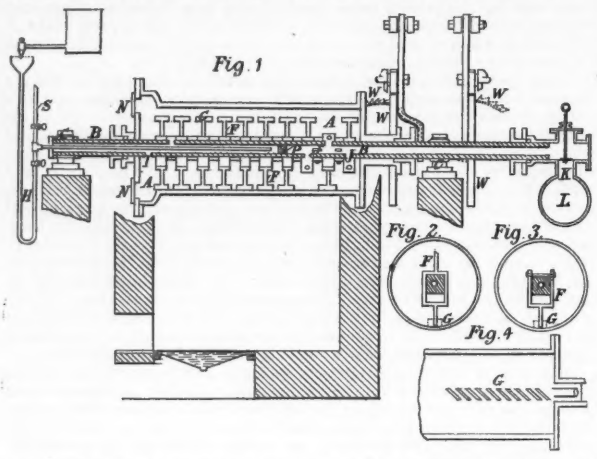


fig. 3. The central opening is oblong, and just larger than the side of the shaft in one direction, but considerably more in the other; so that, as it is turned round, it slides across the shaft to allow each scraping-plate to meet the surface of the retort at each revolution. The plate C is bevelled back from the surface that touches the retort at an acute angle, so as to form a sharp scraping edge; and it is rounded on the face to the curve of the retort. The scraping-pieces may be placed on the shaft, with the arms alternately at right angles to each other, or in one line. In the latter case, they are long enough to overlap each other, and are set at an angle to the shaft as fig. 4, which causes the solid pieces of carbon to collect at one end of the retort. N are doors by which the carbon is drawn from the retort, and to allow of the introduction of tools to loosen and clean out any crusts that may adhere to the scrapers.

The oil is introduced in a regulated stream by the pipe H into the shaft B, where it gets heated and partly vaporized, and passes into the body of the retort by the openings I. There it is converted into permanent gas. This passes out of the retort by the openings J into the shaft; and thence, by the valve K, into the gas-main L. A plug P is inserted into the shaft, dividing it into two portions—one for the introduction of the oil, and the other for leading the gas away from the retort. The branch-pipe S on the oil-pipe supplies the necessary steam.

In working the apparatus, the retort is heated as uniformly as possible to the temperature required; a low heat giving a richer gas, but less in volume, than a higher heat. The uniformity of the heat is obtained by keeping the retort well above the furnace-bars, and by its revolution. After a certain quantity of oil has been used, and the corresponding quantity of gas obtained, the revolutions of the shaft and retort are stopped; the current of oil shut off; and steam is turned on gently, to sweep the gas out of the retort. The valve K on the main L is then closed, when one or both doors N are opened, and the carbon raked out. When it is seen that the apparatus is clean, and the openings in the shaft clear, the doors are again closed, and the operation recommenced.

Purification of Coal Gas.—Walker, C. C., of Donnington, near Newport, Salop. No. 1659; Jan. 25, 1894.

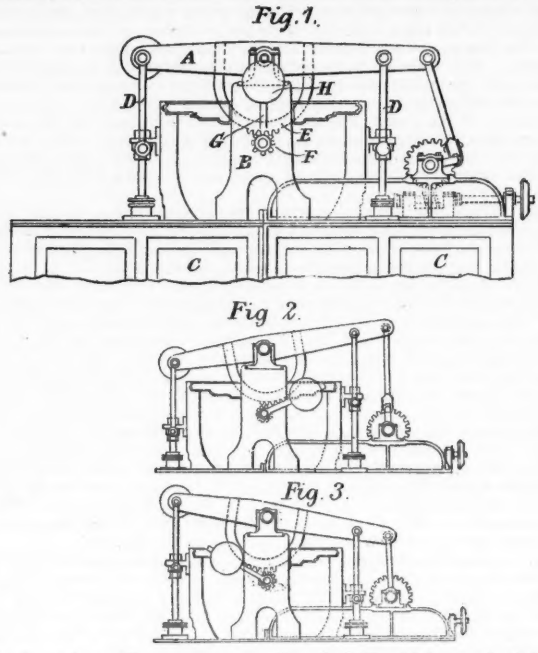
This invention relates to apparatus to be used in the purification of coal gas, or for analogous operations, wherein dipping-devices at either end of a rocking-beam are alternately lowered into, and raised from, liquid—such as the apparatus described in patents No. 1478 of 1880, and No. 14,925 of 1888.

In working such apparatus, when the beam is horizontal, and the dipping-devices at each end of the beam are submerged in the liquid to an equal extent, the weights at each end of the beam are equal. When, however, the dipping-devices at one end of the beam are submerged in the liquid, and the dipping-devices at the other end of the beam are raised from the liquid, or the one device is more deeply submerged than the other, the difference in resultant weight, owing to the buoyant effect of the liquid on the submerged devices, causes the engine driving the machine to have an unequal load to overcome during each stroke of the beam of the machine. The object of the present invention, therefore, is to compensate for this difference in weight, so as to cause the engine to have practically an equal load to overcome during each stroke of the beam, by providing it with a weight which is moved over alternately to one side and the other as the beam oscillates; and thus counteract the difference due to loss of weight by the buoyancy of the submerged, or more deeply submerged devices as they are alternately lowered into the liquid.

Fig. 1 represents in elevation so much as is necessary of the apparatus; the rocking-beam being horizontal. Fig. 2 is a similar view, showing the beam inclined in one direction to its full extent; and fig. 3 shows the beam inclined to its full extent in the opposite direction—both drawn to a smaller scale than fig. 1.

A is the rocking-beam pivoted to standards B on the top of the tank C containing the purifying liquid, to the opposite ends of which beam dipping-devices are connected by rods D. To the mid part of the beam A is affixed a toothed sector E; and engaging with this sector is a pinion F, whose axis is mounted in bearings in the standards B. Secured to the axis is an arm G, carrying a weight H sufficient to exert a leverage on the beam about equal to the difference in weight owing to the buoyancy when submerged of the dipping-devices carried by the lever.

The rocking-beam is operated from a motive power engine by any suitable means—for example, as shown, one end of the beam A is connected by a rod to a crank on a shaft, on which is keyed a worm-

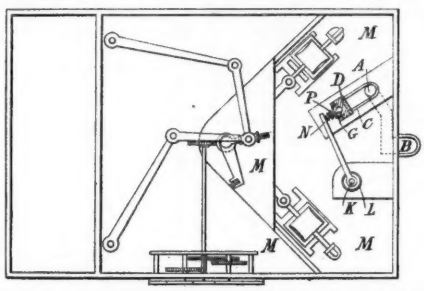


wheel gearing with a worm on another shaft K, which may be driven by gearing direct or otherwise from the engine, and thereby impart to the beam the desired rocking movement.

When the beam is in its horizontal position (as in fig. 1), the arm G and weight H are in a vertical position. Consequently the weight does not preponderate on either side of the fulcrum of the beam; but, as the ends of the beam are alternately lowered and raised, the sector E rotates the pinion F, and moves the weight H alternately over to the one and then to the other side of the fulcrum, as shown in figs. 2 and 3.

Coin-Freed Gas-Meters.—Glover, R. T. and J. G., of Clerkenwell, E.C. No. 6058; March 22, 1894.

This invention relates to the valves of coin-freed gas-meters; and it consists in loosely articulating the valve to its stem—such as by a ball-and-socket or universal joint—so that it can accommodate itself to any irregularity of position of its seating, to form a tight joint, and prevent the passage of gas to the consumer's pipe until the valve is lifted from its seating after the insertion of a coin. By loosely articulating, or flexibly connecting, the valve to its stem (or the valve-seating to the pipe or other outlet or inlet), no great pressure is required to be put upon the valve to tightly close it. A spring may be used, if desired, to stiffen the valve and keep it upon its seating; its position between the valve and the stem (or a shoulder on the stem) allowing the valve to yield to pressure when making contact with its seating, so as to gradually close it without any dead-beat action or shock.



The illustration is a plan of an ordinary dry meter; the top cover of the meter and of the interior valve-box being removed, to show the valve constructed according to the present invention, and the position it preferably occupies in meters when applied thereto in connection with coin-freed apparatus by which its movement is controlled.

The pipe A is in connection with the inlet-pipe B of the meter; and its end C forms a seating, against which a rubber or other resilient washer D abuts, so as to shut off the entry of gas to the meter bellows. The washer is attached to a socket-piece, in which a ball at the end of the stem G is retained by a plate and screws. Between this plate and the lever or arm N is arranged a spring P, which serves to keep the valve in proper position. The arm N is attached to the spindle K, which passes down through a stuffing-box and gland L into the valve-chamber M; and it may be in connection with any kind of actuating mechanism—such as a coin-freed prepayment apparatus, which, after the insertion of a given coin, will open the valve or allow of its being opened by the consumer; the closing of the same being effected by the meter mechanism, in conjunction with the prepayment apparatus.

In delicately-arranged apparatus such as is necessary in coin-freed gas-meters, the patentees point out that it is important, in order to prevent leakage and waste, that the valve should close evenly upon all parts of its seating, with a pressure that will not put any strain upon the meter mechanism. However, if an ordinary fixed valve be used, and there occurs any irregularity in the position of its seating, very

considerable pressure is needed to cause the washer D to close upon its seating C all round. This pressure sometimes will not be obtained, and leakage from the opening Q must result. To obviate this, the inventors propose to employ loosely-articulated valves, preferably of the kind already described; but in some cases the ball-and-socket joint may be dispensed with, and a spring used, the flexibility of which will allow the valve to assume any angle, and will at the same time yield to the pressure put upon it by the meter mechanism, and thereby prevent any binding or jamming of the operative parts.

Liquid Meters.—Bernhardt, W., of Vienna. No. 7392; April 13, 1894.

This liquid meter is of the class in which the liquid that flows into the apparatus is compelled to pass through a kind of turbine, so as to rotate the wheel thereof, and thereby operate a counting apparatus that registers the quantity of liquid passing through the meter. Liquid meters of this kind have, according to the patentee, hitherto possessed the disadvantage that, as soon as the pressure of the liquid sinks below a certain limit, the turbine ceases (in consequence of the low pressure acting on its vanes) to rotate at a velocity corresponding to the quantity of liquid passing; so that the counting-apparatus indicates a smaller quantity of liquid than actually passes through the meter.

The present invention is designed to obviate this disadvantage, for which purpose the liquid (after passing through a mud-catcher or filter) is caused to flow through a pressure regulator comprising differential weights, which are free to fall and close the main or ordinary inlet, and which form, with annular ribs arranged in the casing of the regulator, an automatic valve that influences the velocity of the turbine-wheel, and automatically closes the inlet when the pressure of the liquid falls below a certain limit. The liquid can then reach the turbine-wheel only through one or more tubes connected with a certain number of inlet-passages in the cylinder of the turbine.

Prepayment Gas-Meters.—Milsted, W. N., of New York. No. 17,757; Sept. 18, 1894.

This invention relates to automatic gas-meters; fig. 1 being a front view of the meter, fig. 2 a sectional plan, and fig. 3 a sectional elevation.

Fig. 1.

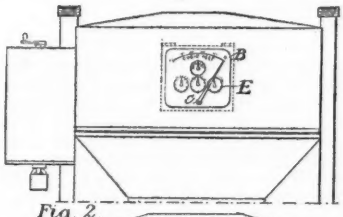


Fig. 2.

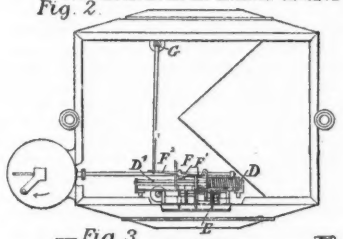
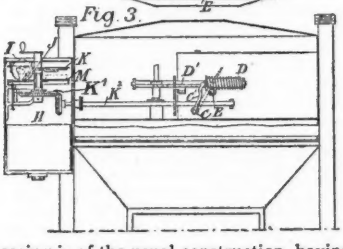


Fig. 3.



The meter casing is of the usual construction, having a dial-plate on which are the dials for the feet—thousands and tens and hundreds of thousands. There is also an extra dial B, showing, by a hand on the shaft C, the number of cubic feet paid for but not used. The shaft C has at its opposite end, within the meter casing, an arm C^1, bearing against a sliding worm D on a spindle D^1, squared or polygonal or provided with a feather, mounted in bearings on the index-plate. This worm gears with a pinion formed on the shaft E of the indicator of the thousand-feet dial, as shown in fig. 1. The shaft D^1 is turned by a coin-controlled mechanism; so that when a quarter dollar is placed in position and the coin-controlled mechanism turned, it moves the shaft D^1, and the worm D is fed forward—the pinion acting as a fixed nut for the worm. By placing suitable wheels between the spindle K^2 and D^1, the latter might be turned in the reverse direction when necessary.

As the worm is fed forward, it moves the arm C^1 in the direction of the arrow; and as this arm is on the spindle C, the hand is moved in the direction of its arrow to the 200 point. When this amount of gas is used, the spindle E of the indicator mechanism pushes the worm D back to its normal position; and the arm C^1 follows—being pressed by a spring always against the end of the worm D.

In order to arrest the operation of the meter when the worm has reached the limit of its rearward movement, there is an arm F pivoted on a bracket projecting from the index-plate; and one end F^1 of this arm is urged by a spring to fall in front of the worm D. The other arm F^2 extends into a path of an arm of the rod G. A pin on the arm F^2 checks the movement of the arm, and consequently checks the movement of the rod, which carries one of the heads of the bellows of the meter. Thus the bellows cannot make their full distance, and the valve mechanism controlled by the rod cannot make its full throw. Consequently the meter is stopped, and the supply of gas is cut off. A spring pawl pivoted to the arm F^1 of the lever yields when the spindle D^1 is turned on the insertion of a coin; and this arm being pushed out by the worm D, the arm F^2 is moved clear, and allows the meter to measure again.

The coin-operating mechanism is shown in fig. 3. It consists of a box H, secured to one side of the meter, having in its bottom a money receptacle confined to the box by a bar, with a staple for a padlock. In the upper part of the box is a coin-slot I; and directly under the top is a disc, having a slot provided with a handle, by which it is turned. This disc is mounted on a vertical stud J, carried by a bracket attached to the side of the money-box. When a coin is inserted in the slot in the disc, the disc must be moved in the direction of the arrow (to the discharge point) in order to register, and then must be moved back. It cannot be turned a full turn, as it is stopped by a projection on the casing, meeting a projection on the disc. Directly under the top disc is a second disc K, having a coin-slot, which must coincide with the slot in the disc and with the slot I in the casing before a coin can be inserted; and when a coin is inserted (as shown in fig. 3), the coin itself locks the discs, and they both travel forward together to the point of discharge, which is in the opposite side of the casing. The disc K is fixed to a hollow shaft K^1, to which is attached a bevel wheel, gearing with a bevel pinion on the spindle K^2. This spindle extends into the meter; and it has on it a wheel which gears with a wheel on the spindle D^1, so that, when the disc K is turned, the shaft D^1 is also turned to an extent dependent upon the manner in which the disc is geared to the spindle. Thus the worm D is fed forward the required distance.

M is a plate mounted on the shaft K^1, fixed to the casing, and extending into one of the holes in a plate provided with a coin-slot and a lug adapted to stop the rotation of the disc K by the lug on the disc coming in contact with another lug when the discs I and K are turned. In this way, when all the coin-slots coincide, the coin is released from the discs I and K, and falls into the receptacle H. On the upper face of the plate M are ratchet-teeth, with which the lower edge of the coin engages; so that, as it is moved forward, it passes over these ratchet-teeth, but cannot return. Thus the disc cannot be turned backwards and forwards.

The plate M can be adjusted by setting a pin in any one of the different holes, according to the price of gas. Thus, if the plate is set for gas at $1·25 per 1000 cubic feet, and if the gas is less than this price, the plate is turned so that the distance between the coin-slots is greater; but if it is more, the plate is moved so as to shorten the distance between the slots. On the edge of the plate M are a series of numbers, indicating prices of gas; and in the casing H is a glazed sight-hole, through which can be seen the division at which the plate is set.

Softening Waters and Purifying the Waste Liquors.—Doulton, H. L., and Manger, A. W., of Lambeth. No. 18,932; Oct. 6, 1894.

This invention in the softening of waters and purifying waste liquors is intended mainly for use in connection with the apparatus described in patent No. 15,169 of 1893. The object of the present improvements is to obtain a clearer and purer saturated solution of such reagents as are used for the precipitation of the carbonates in hard waters, and for the treatment of the various impurities met with in sundry waste liquors; also to provide for a continuous and automatic and thoroughly efficient process of softening or purifying. The invention comprises chiefly the provision of a quiescent tank in connection with the agitating tank for reagents, an improved arrangement of reagent and settling tanks, of water-regulators, and of the final manganous carbon filter, and other appliances in connection therewith.

Regulating the Supply of Lubricating Oil to Gas Exhausters, Pumps, and Rotary Engines.—Chester, W. R., of Nottingham. No. 19,578; Oct. 15, 1894.

One form of this patented arrangement is shown in fig. 1—a vertical sectional view of the type of apparatus to be used when the specific gravity of the lubricant is less than water. The second modification, shown in fig. 2, is of apparatus used when the specific gravity of the lubricant is greater than water. Fig. 3 is a vertical sectional view of a sight-feed lubricator which may be attached to either apparatus.

Fig. 1. *Fig. 3.*

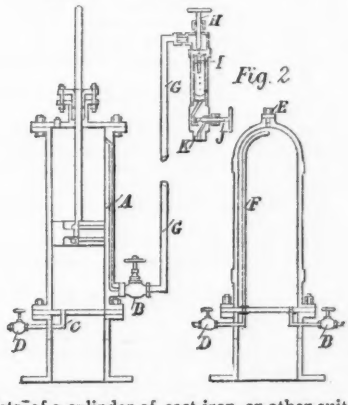


Fig. 2.

Fig. 1 consists of a cylinder of cast iron or other suitable material, provided with a piston and piston-rod working through a gland at the top of the cylinder, which has a duct or oil-passage A cast in the side, with a boss at the bottom attached to a stopcock B, for shutting off or regulating the flow of the lubricant. At the bottom of the cylinder is

a steam or water supply-pipe C, provided with a stop-valve or cock D, to regulate the supply of steam or water under pressure.

Before putting the apparatus into action, the piston is pushed to the bottom of the cylinder; and the space above it is filled with the lubricant through a hole, afterwards closed with a plug E. Steam or water under pressure is turned on at the stop-valve D attached to a steam supply-pipe, at a slightly greater height than the top of the cylinder; thus ensuring a supply of condensed water only to the cylinder, which (acting on the underside of the piston) subjects the lubricant to a similar pressure to that in the supply-pipe. If the pipe be coupled to a water supply-pipe under pressure, then the pressure of the water acts in a similar manner on the underside of the piston; thus subjecting the lubricant to a similar pressure to that of the water.

In the modification shown in fig. 2, when empty, the cylinder is filled with lubricant through a hole at the top, afterwards closed with a plug; and the steam or condensed water is admitted through a pipe F passing through the bottom of the cylinder, and connected to a stop-valve D, to regulate the supply of steam or water from the pipe C, as described in fig. 1. The pressure being on the top of the lubricant, the lubricant is forced through a pipe G into a sight-feed lubricator, like that shown in fig. 3. The bottom of the pipe G is attached to a stopcock B connected to the bottom of the cylinder.

The sight-feed lubricator regulates the flow of lubricant to the exhauster, pump, or rotary engine; and it is common to both forms of cylinder—being attached to either of the stopcocks B. The lubricant, regulated by a valve H, is admitted to a glass tube, at any reasonable speed, through a nozzle I. Below the glass tube a duct is arranged to form a seal, in order to prevent any of the tarry gases, vapours, or liquids escaping from the exhauster into the glass tube, discolouring it, and destroying its usefulness as a sight-feed. The lubricant is admitted by a valve J, which also serves to shut off the gas in case the apparatus requires to be taken to pieces for cleaning or repairs. The apparatus is attached to the exhauster by a screw K.

APPLICATIONS FOR LETTERS PATENT.

23,167.—Saunders, C. J., "Clay and other fire-balls used for gas-fires, &c." Nov. 29.

23,186.—M'Laren, W., and Brown, H. E., "Railway-carriage and other roof lamps." Nov. 29.

23,230.—Horsfall, R. V., "Retorts for distilling, cracking, or gasifying oils, tars, or any liquid hydrocarbons." Nov. 30.

23,278.—Bosselaar, J. M., and Elshout, J. F. M. van den, "Manufacture of gas." Nov. 30.

23,349.—Hayes, G., "Gas and lamp shades." Dec. 1.

23,364.—Bousfield, E. T., "Oil and gas engines." Dec. 1.

23,392.—Armstrong, J., "Incandescent gas-lamps." Dec. 3.

23,442.—Burton, J. J., and Cooper, S., "Temporarily closing lead or iron pipes, &c." Dec. 3.

23,454.—Guldlin, O. N., "Water-gas apparatus." Dec. 3.

23,455.—Guldlin, O. N., "Oil-feeding apparatus for gas-generators." Dec. 3.

23,496.—Winstanley, G., and Robinson, G. H., "Fastening the lids of retort mouthpieces and the catches of same." Dec. 4.

23,552.—Fennessy, F. R., "Oil, gas, or vapour burners for heating purposes, and heating stoves or ranges employed therewith." Dec. 4.

23,571.—Ostlund, C., "Vapour-burners." Dec. 4.

23,572.—Goodwin, A., "Meters for measuring liquids." Dec. 4.

23,590.—Barnett, H. T., "Gas batteries." Dec. 5.

23,617.—Lamb, J., "Lamp chimney or globe or covering for any kind of light." Dec. 5.

23,631.—Greg, A., "Purification and utilization of wood gas for illuminating purposes." Dec. 5.

23,651.— Kitto, F. W., and Haworth, W., "Gas, oil, and other heat engines." Dec. 5.

23,662.—Henderson, J., "Gas-retorts." Dec. 5.

23,665.—Falk, S., "Lamps." Dec. 5.

23,671.—Dvorkovitz, P., "Treatment of liquid hydrocarbons, and production therefrom of gas and valuable bye-products." Dec. 5.

23,715.—Redman, T., "Mounting gas-burners." Dec. 6.

23,790.—Barwise, S., "Preventing the bursting of lead or other pipes or tubes through expansion or pressure from within." Dec. 7.

23,807.—Brotherton, J., Ltd., and Love, E., "Tube joints or couplings." Dec. 7.

23,818.—Malgarini, A. F., "System of construction applicable to buildings, reservoirs, canals, pipes, and other structures." Dec. 7.

23,826.—Livesey, F., and Sugg, W. T., "Gasholders." Dec. 7.

23,859.—Tailyour, W. S., "Utilization of natural and artificial mineral or hydrocarbon oils and their various products and bye-products in producing heat and making and enriching gas." Dec. 7.

23,865.—Sherwin, G. E., "Crushing and grinding coke and other materials." Dec. 8.

23,890.—Kingston, H. S., "Regulating the supply of air to burners of incandescent gas-lamps." Dec. 8.

24,005.—Glasgow, A. G., "Carburetting water gas." Dec. 10.

24,032.—Alexander, W., "Prepayment gas-meters." Dec. 11.

24,074.—Boult, A. J., "Fluid-meters." A communication from Hegenscheidt Bros. and Theodore Derichs. Dec. 11.

24,081.—Guy, J., "Heating attachments for gas, gasoline, oil, and other cooking-stoves." Dec. 11.

24,084.—Holliday, V., "Gas or other explosive engines." Dec. 11.

24,089.—Marks, G. C., "Gas-engines." A communication from F. Hirsch. Dec. 11.

24,133.—Heys, W. E., "Gas and similar engines." A communication from L. Letombe. Dec. 12.

24,229.—Buttrum, P. H. D., and Thorneycroft, W., "Portable and adjustable incandescent gaslight apparatus for photographic or other purposes." Dec. 13.

24,231.—Peebles, D. B., "Coin prepayment gas-meters." Dec. 13.

24,236.—Beal, W., "Pendants for gas and other lights and lamps." Dec. 13.

24,239.—Withers, S., "Gas-engines." Dec. 13.

24,256.—Westwood, W. E., Wright, E. T., and Westwood, W. S. W., "Telescopic gasholders." Dec

CORRESPONDENCE.

[*We are not responsible for the opinions expressed by correspondents.*]

Mr. George Livesey and the Meter Makers.—A Disclaimer.

Sir,—I regret having to write on a trivial matter; but a leading meter maker called on Thursday last, to inquire whether the circular of Messrs. W. Coward and Co., with a reprint of my first letter to the Journal, on "Combinations"—which they have distributed broadcast—was issued by my sanction. He informed me that in some places this impression existed; and he said it would be well, if I had no objection, to remove all ambiguity on the subject.

I have had nothing whatever to do with the issuing of the circular—not even having read it until last Thursday night. The responsibility for it, so far as I am concerned, rests entirely with Messrs. Coward and Co. Now, however, that the meter makers have shown a willingness to meet their customers fairly, I should certainly deprecate an increase in the number of meter-making firms; for I believe there are already enough (and perhaps more than enough) to meet all the requirements of the trade. If that is so, any addition only means that another establishment must somehow be supported out of the trade, or the money expended in starting it lost; and certainly neither alternative is desirable.

George Livesey.

Dec. 29, 1894.

The Stability of Gadd and Mason Gasholders.

Sir,—In view of the letter from "Inquirer" in the Journal for Dec. 18, will you permit us to state that, during the recent unprecedented gales, the whole of the Gadd and Mason patent spirally-guided gasholders have worked entirely satisfactorily? These gasholders are securely guided from the base; and several which are erected close to the sea, or in very exposed positions, have withstood the full force of the wind pressure—thereby fully verifying our statements, that they are the most stable under all conditions.

These gasholders will, we consider, be still further strengthened by the latest improvements, particulars of which will be found in the Journal for Dec. 11, p. 1121.

R. & J. Dempster, Limited.

Newton Heath, Manchester, Dec. 26, 1894.

The Use of Flueless Stoves in Confined Rooms.

Sir,—The results of Dr. Haldane's researches, recently placed before the British Association, are of considerable importance to all users of gas for lighting and heating purposes. It has been frequently stated that the presence of carbon dioxide in the air (caused by combustion of gas) is injurious; and the persons who have made this statement, without any direct proof, have repeated it until apparently they actually believe it themselves. It has for many years been well known to experts that a very much larger proportion of carbon dioxide than usually exists in the air can be inhaled without any injurious effect, and that this gas is really as inert as nitrogen, which is by far the largest constituent of the atmosphere. But Dr. Haldane's researches show clearly that an excessively large proportion of carbon dioxide may be inhaled with ordinary air without risk, and with little discomfort. Ordinary fresh air contains about 1 part of carbon dioxide in 3000 parts; yet this may be increased to one hundredfold before any difference can be appreciated in the respiration—*i.e.*, the presence of 3 per cent. of this gas (100 times the normal quantity) can only be appreciated by a chemical analysis, and not by persons breathing the mixture. When the percentage increases beyond this, the person breathing it commences to pant; but even with 10 per cent., only a temporary headache is produced, and there is no danger until the proportion rises to 18 per cent.

Foul air in a room is not dangerous from any quantity of carbon dioxide which can be formed by combustion, until the combustible itself is extinguished owing to want of oxygen. A candle goes out in an atmosphere containing 18 per cent. instead of the usual 21 per cent. of oxygen, and 2½ per cent. of carbon dioxide—*i.e.*, human beings can live and breathe in an atmosphere which will not support the combustion of a candle. The experiments show that, in colliery explosions, the carbon dioxide formed is not sufficient to affect life, unless the oxygen is almost entirely removed; and Dr. Lorrain Smith found that he could breathe ordinary air from which one-half of the oxygen had been removed, without inconvenience or visible effect. We may safely take it for granted that any amount of carbon dioxide formed by the combustion of coal gas in an ordinary room, under ordinary conditions, would be inappreciable, except to delicate chemical analysis; and that the only possible products of combustion from this source which could be injurious are sulphurous and sulphuric acids and carbon monoxide. The two former are unpleasant; but no stretch of imagination could consider them more than this. The last is undoubtedly dangerous; but, *if the combustion is perfect*, recent careful researches show that it is not formed.

We appear to be brought to the fact that the products of combustion from gas-lights and flueless gas-stoves are inert, and, in the absence of sulphur compounds, are inappreciable to those persons who are in the room. The question remains: Why is a room in which a flueless gas-stove and ordinary gas-lights are used so unpleasant—causing, in most cases, cold feet and headache? The answer is, I think, a very simple one. In a room warmed by radiant heat alone, by an open gas or coal fire, the temperature at the floor-level will be found, in every case, at least the same as, if not higher than, that of the upper part of the room. In certain parts near the fire, a much higher temperature can be obtained at the floor-level; and these parts of the room are always selected instinctively by those who wish to be seated in comfort. With a flueless stove, certain classes of burners are absolutely necessary. The flames must be free, and not obstructed by solid matter, such as asbestos, iron, or fire-clay; any of these causing the evolution of more or less carbon monoxide. Without these, any large proportion of radiant heat is, so far as is known

at present, impossible. The larger proportion in a flueless stove must of necessity be convected heat, which rises with the currents of air formed. The natural consequence is that the temperature of the floor-level will, in almost every case, be lower than that of the upper part of the room; and the old advice to "keep your feet warm and your head cool" is unattainable. This does not matter in a bedroom, where the whole body is at one level; and (though I am without much personal experience on this point) I believe it will be found that, in a bedroom with a chimney which has a down-draught, flueless stoves may be used with perfect safety and comfort if they are made with ordinary lighting burners, or, if the light is objectionable, with good atmospheric burners, the flames of which are clear, and unobstructed by any solid matter. My own experience is limited to a period of about three years, during which my private workshop, having no flue, was heated by a stove containing ordinary Bray's union-jets. I worked in this for many hours each day, and felt no inconvenience; but I was standing, and constantly moving about. If I had been quietly seated for an hour or two, the consequence would have been, as I have repeatedly proved, cold feet and a headache.

The matter is worthy of consideration; and no doubt many of your readers will have an opportunity of testing the point raised, in cases where invalids with diseases of the respiratory organs are confined to bedrooms in which a fire is impossible owing to a down-draught in the chimney. The question is an important one in many cases of lung diseases, which have to be treated in private houses where proper heating arrangements are otherwise impossible. It must be clearly understood that I do not commit myself to any positive statements, except that the matter appears worthy of extended practical trial; and the results, whether for or against, will be valuable.

Grappenhall, Warrington, Dec. 27, 1894. THOS. FLETCHER, F.C.S.

The Dangers of Electric Light Wires.—Soon after midnight last Tuesday, a fire broke out in the house of the landlord of the Café Sylvani in the Chaussée d'Antin, Paris, and for some time threatened to assume alarming dimensions. According to the Paris Correspondent of the *Daily Telegraph*, the cause of the fire was stated to have been the "sudden ignition of electric wires." It began on the ground floor of the house, and at one time the flames reached the fifth storey. The timely arrival of the firemen, however, enabled them to be extinguished before much damage was done.

The Gas Workers' Union.—The Oldham branch of the Gas Workers' and General Labourers' Union recently held their annual *soirée*; and, in the course of the proceedings, Mr. J. R. Clynes, one of the district officials, addressed those present. He claimed for the Union that it was the strongest organization of so-called unskilled labourers in the kingdom; the total income for the past year being £14,759. Above £50,000 had been paid in workmen's claims by the Union since its establishment five years ago; and even under the present bad Employers' Liability Law, upwards of £1000 had been secured as compensation during the past twelve months for members who had met with accidents while following their employment.

The Manchester Corporation and the Lonsdale Estates.—Mr. Christopher Oakley, the Umpire appointed by the Board of Trade in the arbitration proceedings between Lord Lonsdale and the Manchester Corporation, in regard to the claim by his Lordship for £8500 in respect to wayleave and the value of minerals taken by the Corporation in the construction of the Thirlmere aqueduct, has given his award, allowing £1664 for wayleave and £327 for minerals taken and used; making a total of £1991—£9 less than was offered on behalf of the Corporation with a view to an amicable settlement being arrived at. The claims of the other proprietors were settled by the Corporation; and, in addition to offering Lord Lonsdale £2000, they were willing to pay all the claimant's expenses.

Smoke and Fumes Annihilator, Limited.—A Company under this title has just been registered, with a capital of £120,000 in £5 shares, "to carry on business as manufacturers of smoke annihilators and other apparatus for the treatment of smoke or fumes; to manufacture and deal in carbon, ammoniacal or other liquor, and all other residual products obtained in the treatment of smoke or fumes; to adopt an agreement, made Dec. 8, 1894, between S. Elliott of the one part and W. Arnold, on behalf of the Company, of the other part; and to carry on business as general engineers, ironfounders, machinists, builders, painters, chemists, &c." Among the first signatories are the Duke of Westminster, the Earl of Carnarvon, Lord E. Hamilton, and Lord Wantage; and one of the Directors is Mr. S. Holman, M.Inst.C.E.

The Recent Gale.—The furious gale which prevailed at the close of the week preceding our last publication caused disastrous damage in several parts of the country, and especially in Yorkshire. But, so far as we can learn, gas-works generally escaped with little injury. The most serious accident appears to have been at Cleckheaton, where an iron condenser, consisting of three immense tubes, approaching 20 feet in height, with a heavy top, was blown over, and fell upon an adjoining workshop in the occupation of a joiner and cabinetmaker. The upper storey of the building was completely demolished; and three men who were at work were injured. The Gas Engineer (Mr. G. H. Niven) at once summoned the members of the Gas Committee, as well as medical aid. While the injured were receiving attention, Mr. Niven had a serious task on hand, owing to the escaping gas taking fire at the workshop stove, and the roof of the retort-house being also damaged by the gale. For a time, the stokers had to be called out, owing to the imminence of danger, and the fire brigade also arrived on the scene to deal with the outbreak of fire; but no further serious results were experienced. The damage to the property will, it is stated, amount to some hundreds of pounds; but it is hoped that none of the personal injuries will prove serious. Mr. Niven was able to effectually deal with the emergency so far as the production of gas was concerned; and no inconvenience was suffered in this respect. We also learn that at the New Wortley gas-works of the Leeds Corporation a gasholder column was blown down; and the roofs of some of the buildings were stripped of slates.

LEGAL INTELLIGENCE.

JUDICIAL COMMITTEE OF THE PRIVY COUNCIL.

Saturday, Dec. 8, 1894.

(*Present: Lords* WATSON, HOBHOUSE, SHAND, *and* DAVEY.)

In re the Prolongation of the Semet-Solvay Patent.

In the JOURNAL for the 27th Nov., we announced that the Judicial Committee of the Privy Council (consisting of Lords Watson, Hobhouse, Macnaghten, and Shand, and Sir R. Couch) had decided to advise Her Majesty to grant the petition of M. Louis Victor Semet, M. Ernest Solvay, and the Société Solvay et Cie., for an extension of certain letters patent granted to them. As the petition raised some important considerations of patent law and procedure, their Lordships stated that they would give, on some future occasion, the reasons for their decision. This they accordingly did.

Sir R. E. WEBSTER, Q.C., M.P., and Mr. WAGGETT appeared in support of the petition; the ATTORNEY-GENERAL (Sir R. T. Reid, Q.C., M.P.) and Mr. HENRY SUTTON represented the Crown.

Lord WATSON, in stating the Committee's reasons, said: The letters patent of which an extension is craved were issued to the petitioners Semet and Solvay, who were the inventors, on Nov. 17, 1880. At that date the invention was not protected in any foreign country; but patents were subsequently obtained in France, Germany, Austria, Belgium, the United States, Russia, and Spain. With the exception of the last two, these patents are still in force. The French patent will expire in the course of next year; the German, in 1896; the Austrian, in 1897; and those for Belgium and the United States, in 1900. The Russian and Spanish patents have lapsed in consequence of the failure of the patentees to comply with a condition of their exclusive privilege, which required that the invention should be brought into actual operation within a time limited. The patentees have assigned their whole interest in these patents to the other petitioners, the Société Solvay et Compagnie—a concern in which they are both shareholders. The petitioner Solvay is a Director of the Company, while the petitioner Semet is employed by them, and receives as remuneration a percentage of the profits derived from the use of the invention. The patent is for improvements in apparatus for coking and distilling coal; and its chief merit appears to consist in the substitution of fire-clay tubes for the brickwork flues, forming part of the structure of the kilns or ovens which were previously in use for carrying off the products of combustion. The advantage of the substitution is twofold—in the first place, it prevents the escape of these products from the flue into the oven, through leakage, to the detriment of the coke; and, in the second place, it permits the repair of the flues without taking down the brickwork of the oven. Although the invention is apparently a very simple one, it is proved to be of considerable commercial utility. It not only effects a saving in the cost of maintaining the coking apparatus, but it yields a much larger percentage of coke, with a considerably increased amount of the products of distillation. Their Lordships have, in these circumstances, had no difficulty in coming to the conclusion that the invention is of sufficient merit to justify them, if the other circumstances of the case be favourable, in recommending an extension of the patent. That neither the patentees nor the Company which has been engaged in bringing their invention under the notice of the public in this and in other countries have been adequately remunerated, is established beyond doubt. The accounts produced and proved show a large debit balance; and the cross-examination of the petitioners' witnesses by Counsel for the Crown, and their observations upon the evidence, merely went to show that the pecuniary loss of the petitioners may ultimately prove to be less than they anticipate. In some circumstances, the fact that such losses have been sustained during the currency of the patent might go far to show that the patented invention was not of public utility; but their Lordships are satisfied that there is no room for such an inference in the present case. The invention appears to them to be one which, from its very nature cannot reasonably be expected to come at once, or within a short period, into general use. Its adoption necessitates the destruction of existing, and the erection of new apparatus; and it will therefore, in all probability, be gradual, as the old-fashioned apparatus wears out. Their Lordships' attention was very properly directed by the Attorney-General to the enactments of section 25 of the Patent Law Amendment Act, 1852, which apply to cases where a foreign invention has not been first patented in the United Kingdom, and also to a series of decisions of this Board, in which it was held that cases in which the foreign invention was first patented in this country, though not within the letter, were within the spirit of these enactments. Their Lordships do not consider it necessary to notice these decisions in detail. In this case, the patent is dated before the passing of the Patents, Designs, and Trade Marks Act, 1883; and had it not been the first granted in any country, the question might have arisen whether, having regard to the terms of section 113 of the later statute, their Lordships were bound to deal with the case as falling under section 25 of the Act of 1852. But their Lordships do not think that, prior to the passing of the Act of 1883, this Board had laid down any rule to the effect that cases in which the British patent was the first were within the spirit of section 25 in such sense that its enactments ought to be strictly applied to them. The decisions already referred to go no farther than to establish that, in dealing with such cases, the lapse of patents for the same invention in foreign countries and the policy of the Legislature, as indicated in section 25, were circumstances to be taken into account in considering whether or not a prolongation ought to be granted. Thus, in the case of the Bett's patent, three patents had been obtained, in Britain, France, and Belgium—the British being the first of them; and this Board advised Her Majesty to grant an extension for five years, although the Belgian patent had expired before the date of the application for renewal. Their Lordships are of opinion that, inasmuch as section 25 of the Act of 1852 does not apply to it, the present case must be dealt with under the provisions of the Act of 1883, and therefore on the footing that section 25 has been repealed by the Legislature. The rule laid down for their guidance by

section 25 (4) of the later Act is to the effect that "the Judicial Committee shall, in considering their decision, have regard to the nature and merits of the invention in relation to the public, to the profits made by the patentee as such, and to all the circumstances of the case." The practical result of that legislation is that the Committee are no longer deprived of the right to recommend, in their discretion, the extension of a patent which is not the first in cases where one or more foreign patents for the same invention have lapsed or expired. But the lapse or expiry of foreign patents remains, as it always has been, one of the circumstances which must necessarily be considered. It is a circumstance which may prejudicially affect the interests of the inhabitants of the United Kingdom; and it is therefore one which must be taken into account, along with the other facts of the case, where there is no patent for the invention outside the United Kingdom, as well as in cases where foreign patents exist or have existed. In cases where the prolongation of a patent would place the inhabitants of Great Britain and Ireland at a disadvantage in competition with the subjects of a foreign State, that circumstance must militate strongly against its extension. Whether or not the disadvantage, either certain or probable, ought to outweigh the right of the patentee to obtain a renewal upon other grounds must always be a question of degree, to be decided according to the special circumstances of each case. In the present case, the evidence does not suggest that there is much, or any appreciable, competition in the markets of the world between coke of British and of foreign manufacture, or between articles British and foreign which depend for their manufacture upon the use of coke as fuel. Then, in Russia and Spain—the two countries in which the patents taken out for the present invention have lapsed—the evidence shows that the invention is not used. In these circumstances, their Lordships have come to the conclusion that the patent ought to be extended for a term of five years; and they have humbly advised Her Majesty to this effect.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

Monday, Dec. 17.

(*Before Lord* HALSBURY *and Lords Justices* LINDLEY *and* A. L. SMITH.)

Shelfer v. The City of London Electric Lighting Company—Meux's Brewery Company, Limited, v. the Same.

These were two appeals against a decision of Mr. Justice Kekewich in April last. The plaintiff in the first action is the tenant, under a lease granted to him in March, 1893, by the plaintiffs in the second action, for a term of 21 years, at a rent of £70 per annum, of a public-house called the Waterman's Arms, situate at Bankside, Southwark. The plaintiffs in the second action are the owners of the house. The plaintiff Shelfer by his action claimed an injunction to restrain the defendants from using or working, in or upon their premises at Bankside, which adjoin the public-house, any dynamo or other engine or machinery, in such a manner as, by reason of vibration or otherwise, to injure the structure, fixtures, or fittings of the house, or to interfere with the enjoyment by the plaintiff of the house, or his use thereof for the purposes of his business, or in any way so as to cause a nuisance to the plaintiff or injury to his house or business. The plaintiff also claimed damages for injury arising from the subsidence, vibration, and noise caused by the works and operations of the defendants, and generally for their wrongful acts. The plaintiffs in the second action made a very similar claim. The defendants contended that, in the absence of negligence on their part, they were exempted, by their statutory powers, from any liability to an action for nuisance; and, moreover, that no actionable nuisance had been proved to exist. It was also urged by them that, the plaintiffs in the second action being reversioners, they had no cause of action in respect of a nuisance which was not necessarily permanent, and might have been removed before the reversion fell into possession. Section 82 of the Provisional Order under which the defendants derive their authority to carry on their works, provided: "Nothing in this Order shall exonerate the undertakers from any indictment, action, or other proceeding for nuisance in the event of any nuisance being caused by them." Mr. Justice Kekewich held, upon the construction of the Acts and the Provisional Order under which the defendants obtained their powers, that the defendants were not exempted from liability to an action for nuisance. His Lordship further held, upon the evidence, that it had been proved that, by reason of the working of the defendants' engines, injury was caused to the premises in question by vibration and noise, and also, in some degree, structurally. Having regard to the manifest inconvenience which would result to the inhabitants of the district which the defendants supplied with electricity if their works were stopped, his Lordship did not think fit to grant an injunction. The plaintiff lessee was, however, entitled to inquiries as to the damages caused to him as such lessee by vibration, noise, and structural injury, and to the costs of the action; and there must be judgment to that effect. As regarded the other plaintiffs, their action, so far as it claimed an injunction, must be dismissed with costs; it being clear upon the authorities that, being reversioners, they were not entitled to relief by injunction in a case such as the present. They were, however, entitled to an inquiry as to any damage done to the inheritance; but the costs of such inquiry must be reserved. Both plaintiffs appealed, mainly on the ground that an injunction ought to have been granted. It was said that Lord Cairns's Act did not authorize the substitution of damages for an injunction in such a case as the present.

Mr. WARMINGTON, Q.C., Mr. BADCOCK, and Mr. WAGGETT appeared for the plaintiffs; Mr. MOULTON, Q.C., Mr. RENSHAW, Q.C., and Mr. W. C. BRAITHWAITE represented the defendants.

Lord HALSBURY delivered the following judgment: The two plaintiffs in this case complain of a nuisance created by the defendants by the vibration of their engines, and the annoyance caused by the carrying on of their electric lighting works. Of the result and gravity of the nuisance, no serious denial has been made before us. The two plaintiffs are respectively the lessee and reversioner of the house known as the Waterman's Arms. The considerations which arise are applicable to both plaintiffs, except in so far as one is lessee and the other reversioner. I will deal with this question separately. The nuisance being established, it is said that the defendant Company are authorized by law to carry on the business, and that they have done all that skill and care can effect to prevent any nuisance; also that they are in the same position as a railway company, and are entitled to do what they have done under the authority of the Legislature. If the analogy were a correct one, I should think the defendants had fallen very far short in the proof that they had done all that was possible to prevent a nuisance. A railway company has a definite line of operation, within which it may make its works; and if it does all that can be done to prevent a nuisance in that place, the thing having to be done in that place, and the traffic having to be carried on by means of locomotive engines over the line of railway, the Legislature is taken to have sanctioned that proceeding. No such considerations apply here. There is a difference—the object of the legislation and the results. It is not, however, necessary to deal with this part of the case; and I only mention it to disclaim the notion that I acquiesce in the allegation that it has been here proved that it is essential to the carrying on of the electric lighting business in the district in question that there should be a nuisance created. The main question turns on the Electric Lighting Act, 1882, and the Provisional Orders which have become Acts of Parliament. It was boldly contended by Mr. Moulton that the Order protected the undertaking, and that, if a nuisance were necessarily created by the carrying on of the Company's undertaking, such nuisance was authorized, and even imposed as a duty on the undertakers. I think it is only necessary to read the Order in connection with the 10th section of the Electric Lighting Act, 1882, to dispose of that argument. The provision in the Act, so far as relates to powers under Provisional Orders, is in these words: "The undertakers may, subject to, and in accordance with, the provisions and restrictions of this Act, and of any rules made by the Board of Trade in pursuance of this Act, and of any Licence, Order, or Special Act authorizing or affecting their undertaking, and for the purpose of supplying electricity, acquire such lands by agreement, construct such works, acquire such licences for the use of any patented or protected processes, inventions, machinery, apparatus, methods, materials, or other things, enter into such contracts, and generally do all such acts and things as may be necessary and incidental to such supply." And then, in the Order relied upon for the authority to create the nuisance, come the words: "Nothing in this Order shall exonerate the undertakers from any indictment, action, or other proceeding for nuisance in the event of any nuisance being caused by them." The General Act only gives them power, subject to the restrictions of their particular Order; and the particular Order makes them liable for nuisance. I have also come to the conclusion that the powers given by the 17th section of the Act, read together with the 10th section, are applicable to the execution of the authorized works; and when one considers how frequently the distinction between the execution of the works and the use of them when executed has been the subject of comment and discussion, I think it must be taken that the language used has been deliberately chosen by the Legislature as pointing to the distinction, now well recognized, between the construction of works and the use of them when constructed. But assuming that there is a nuisance, and that there is no authority justifying it, the question still remains: What is the relief to which the plaintiffs are entitled? But for the provision of Lord Cairns's Act, I suppose no one would have doubted that, in the state of facts I have now assumed to exist, the plaintiff Shelfer would have been entitled to an injunction to prevent the continuance of the nuisance. Lord Kingsdown, in the House of Lords (in *The Imperial Gaslight and Coke Company v. Broadbent*, 7 H. L. O., 612), has laid down the principle in words which comprehend such a case as this, as follows: "The rule I take to be clearly this: If a plaintiff applies for an injunction to restrain the violation of a common law right . . . he must establish that right at law, and its violation. I apprehend, unless there be something special in the case, he is entitled as of course to an injunction to prevent the recurrence of that violation." But it is said, and truly said, that the law has been altered by Lord Cairns's Act; and the question is: What construction is to be placed upon this enactment? Undoubtedly it conferred upon Courts of Equity the jurisdiction to award damages which did not exist before. But the question is: Did it mean to interfere with the well-settled principles upon which Courts of Equity were in the habit of interfering in such cases as the present? It seems to me that the defects in the powers of the Equity Courts which were sought to be supplied by that statute, give ample grounds for the provisions of the statute, without supposing that it meant to revolutionize the principles upon which equitable jurisprudence had been administered up to that time. The language, of course, is general; the discretion given is necessarily wide enough in terms to authorize a Judge to award damages where formerly he would have given an injunction. But there is nothing in this case which to my mind can justify the Court in refusing to aid the legal rights established by an injunction preventing the continuance of the nuisance. On the contrary, the effect of such a refusal in a case like the present would necessarily operate to enable a company who could afford it to drive a neighbouring proprietor to sell, whether he would or no, by continuing a nuisance, and simply paying damages for its continuance. But, while I can agree with neither Mr. Warmington nor Mr. Moulton upon the alternative restrictions which each respectively seeks to place upon the statute, I see no trace of any such intended alteration of the principles upon which equity should interfere with an injunction as would be involved in a refusal of an injunction here. And, further, I think the question is here covered by authority. For these reasons, I consider that the judgment of Mr. Justice Kekewich should be reversed as far as the refusal of an injunction is concerned, and that an injunction should be granted. The point which I have reserved for treatment in respect of Meux's action depends on their interest in the premises. They are reversioners; and the action by the reversioners can only be justified if the reversion is affected. But how is it possible to contend that the reversion is not affected, if the walls of the house are so shaken by the nuisance in question that cracks are developed in the building, which experts consider will increase with the increased sources of vibration caused by the erection of larger and more

powerful engines? I think there is ample evidence here of serious and permanent injury to the reversion by the continuance of the nuisance, and that, therefore, the same judgment ought to be given in respect of the reversion. As the reversioners and the leaseholder represent the entire interest, it will be proper, in respect of the assessment of damages for past injuries, to see that the defendants are not made liable for the same damages twice over. The result is that the appeal succeeds so far as the injunction is concerned, and that therefore the judgment of Mr. Justice Kekewich should be reversed in that respect; and the defendants should pay the costs.

Lords Justices LINDLEY and A. L. SMITH gave written judgments concurring.

An "Annual Value" Dispute at Cambridge.

At the Cambridge Borough Police Court on the 15th ult., a case was heard in which the Cambridge University and Town Water Company sought to have a dispute determined as to the annual value of a house and premises known as "Fordfield," in the occupation of Mrs. Wetenhall. The amount claimed by the Company was £2 os. 2d. for a quarter's supply of water. Mr. Rawlinson, who appeared for the Company, maintained that this was really less than they were entitled to charge under their Special Act. By section 36, they had power to charge 4½ per cent. on the annual value of the house. They took the annual value at £130 for the purpose of assessing the rate for domestic supply; and there were certain other services for which an additional sum was charged. The Company, however, only calculated the payment for the domestic supply at 4 per cent.; and in this particular case, they made no charge for high services, of which there were three. Mr. J. C. Jonas, an auctioneer and surveyor, was examined; and he put the net annual value at £150, subject to the tenant paying for all repairs and the insurance. A fair rent in his opinion would be £160 a year. Cross-examined by Mr. Ginn (who represented the defendant), witness said the value of the garden would be from £15 to £20. Mr. Ginn pointed out that what he was going to contend was that, under the Company's Special Act of Parliament, they were not bound to supply water for watering gardens, neither did they, except at certain additional rates; and for the supply of water to the garden, they had actually charged in the rate. Therefore he claimed that a consumer was fairly entitled to take off the value of the garden from the value of the whole property, in order to ascertain the net annual value of the house. Mr. J. H. Moyes, a valuer, was also called by Mr. Rawlinson; and he estimated a fair rent for a tenant from year to year, paying parochial rates and taxes and doing the inside repairs, at £160; the landlord undertaking the outside repairs and paying the insurance. To arrive at the net annual value, he deducted 10 per cent. (£16) for outside repairs and £2 for insurance; leaving the net annual value at £142. Letters which had been addressed by Mrs. Wetenhall to the Water Company were then read. In these she stated that the rateable value of the house was £104, and that any alterations made by the Assessment Committee she would at once recognize as legally binding on her. Mr. Ginn again urged that, in order to arrive at the proper assessment of the house, they must take off the value of the garden, which had been separately assessed; and he cited as his authority the case of the *Bristol Water Company v. Uren*. In this, the Company made an extra charge, in addition to the assessment of the house and garden, for a pipe and a tap; but, by their Act, they were not entitled to charge extra for the tap. In the present case, it was provided that domestic purposes should not include a supply for watering the garden; and if it came within the Bristol case, he admitted that his contention was wrong. Taking the annual value at £160, there should then be deducted one-fifth for repairs, insurance, and any other similar outgoings which a landlord had to pay. The Chairman (Dr. J. W. Cooper) pointed out that this would be a deduction of £32; leaving £128 as the net annual value. This only left a difference of £2 between the parties. Mr. Rawlinson observed that that was so; but the Company had produced evidence showing that it was much higher. After carefully considering the evidence, the Chairman said the Bench had decided to fix the annual value at £130; but they made no order as to costs, though this must not be taken as a precedent.

Reduction in Price.—The Directors of the Exeter Gas Company announce a reduction in price from 3s. 1d. to 3s. per 1000 cubic feet, as from the 1st inst.

The Management of the Newcastle-under-Lyme Gas-Works.—Alderman Briggs, who resigned the offices of Chairman of the Finance and Gas Committees of the Newcastle-under-Lyme Town Council under circumstances reported in the JOURNAL for the 11th ult., has since been asked by both Committees to reconsider his decision. The subject was brought by them before the Council at a special meeting last Wednesday week; and their minutes in regard to the matter were adopted, as well as a recommendation of the Gas Committee, that an independent Auditor should be appointed to investigate the books of the department. The Mayor (Mr. C. H. Hardeman) announced that a deputation had waited upon Alderman Briggs, and explained to him that both Committees were anxious that he should resume the chairmanship; and he promised to reconsider his decision if the resolution which was passed at the last meeting was rescinded, and which he regarded as an indication of want of confidence in the Gas Committee. The Mayor, therefore, proposed that the resolution passed on Dec. 4 with reference to the confirmation and adoption of paragraph 9 of the minutes of the Gas Committee of Nov. 27 be rescinded, and that a special professional auditor be appointed to audit the accounts, the selection of the auditor to be left in the hands of the Committee. This was passed, after a little protest from Mr. Ratcliffe, who also complained subsequently of the bad quality of the gas supplied, and suggested that (as in Stoke, Burslem, and other towns) independent tests should be made of the purity. There were, he alleged, universal complaints regarding the quality. Alderman Whittingham endorsed what Mr. Ratcliffe said, and remarked that the price charged—3s. per 1000 cubic feet net—was rather exorbitant, considering their nearness to the coal-field. The subject was referred to the Gas Committee for consideration.

MISCELLANEOUS NEWS.

THE FALKIRK GAS-WORKS ARBITRATION.

(*Before Mr.* CORBET WOODALL, M.Inst.C.E., *and Mr.* E. H. STEVENSON, M.Inst.C.E., *Arbitrators.*)

Tuesday, Dec. 18.

As intimated in our Scotch Correspondent's "Notes" last week, the proceedings in the arbitration, under the Falkirk Gas Act of last session, to determine the price to be paid by the Falkirk Corporation for the undertaking of the Falkirk Joint-Stock Gas Company, Limited, were opened in Edinburgh to-day, and were continued till the 21st. ult. We give below the first instalment of our report of the proceedings, which will be completed in subsequent issues. In the meantime, it will be of interest to mention that the award of the Arbitrators was delivered in Falkirk last Saturday; the price fixed by them for the undertaking being £77,050. The Company's claim was for £110,000; the Corporation offer (made informally) was £50,000.

Mr. G. P. BIDDER, Q.C., Mr. DICKSON, and Mr. CRABB WATT appeared for the Company; Mr. BALFOUR BROWNE, Q.C., Mr. GRAHAM MURRAY, Q.C., and Mr. JOHN WILSON represented the Corporation.

At the commencement of the proceedings,

Mr. BIDDER made a suggestion, on behalf of the Company, that Mr. Barr, the Umpire, should be present, on the understanding that the Commissioners would not be affected or prejudiced in any action that they might think it desirable to take with the view of questioning the validity of Mr. Barr's appointment, or his competency to act. He said he made this suggestion with the view of rendering it unnecessary for the whole proceedings to be gone over again, in the event of the Arbitrators disagreeing.

Mr. BALFOUR BROWNE said he was sorry he could not consent to this course being adopted, as the Commissioners might hereafter be prejudiced in any action they deemed it necessary to take.

Mr. CORBET WOODALL said he should very much regret if the proceedings had to be repeated; but he understood there was no chance whatever of an agreement as to allowing Mr. Barr to sit.

Mr. STEVENSON said he was afraid the parties would not agree. The matter had been considered by the Arbitrators; and speaking for himself, he felt bound by the wishes of the Commissioners. it was a matter for the authorities, and not for the Arbitrators.

The parties being unable to agree, the arbitration proceeded. The first witness called on behalf of the Company was

Mr. *David Cowan*, M.Inst.C.E., who, in reply to Mr. BIDDER, said he was a Justice of the Peace for the County of Stirling, and was for many years a member of the County Council for the Falkirk and Larbert water supply district. He was generally acquainted with Falkirk and the neighbourhood, and had had very large experience in managing manufacturing undertakings and in making valuations. For two or three years, he was a Director of the Falkirk Joint-Stock Gas Company; and in June, 1893, he was appointed their Local Consulting Engineer. Originally there was only one Gas Company in Falkirk—viz., the Lighting Company. Afterwards, however, the Falkirk Joint-Stock Gas Company was started; and these Companies competed for the supply of gas for a great number of years. As a result of this competition, an agreement was come to in 1888 for combining the two undertakings. At a later period, the original Company started again under new auspices; and they competed with each other—the result being that, in consequence of the agreement, the matter was referred to Arbitrators to settle the relative value of the two concerns. As the result, they fixed the value, as at Jan. 15, 1888, of the whole property and assets of every description of the Falkirk Lighting Company at £13,500, and of the Falkirk Joint-Stock Gas Company at £23,539. Since that time there had been a very large amount of capital expended by the Company upon the works. From 1891 to 1893, they had spent between £15,000 and £16,000 in extensions. At the present time, the plant and works were in good condition. The works at Grahamston were quite capable of supplying present demands; and the East Bridge Street works, which were not now used, were kept in a condition ready for use if a demand sprang up. They had not been employed at all during the last two years. The capacity of the Grahamston works was about 512,000 cubic feet per 24 hours; and that of the East Bridge Street works, 114,000 cubic feet. The present mode of working was by charging the retorts every four hours. Assuming that the retorts were charged seven times in the 24 hours, the capacity of the two would be from 730,000 to 733,000 cubic feet. The maximum output any day during the present year was 267,000 cubic feet in 24 hours at Grahamston. The total output of the works for the year 1894 was 67,113,000 cubic feet. The maximum output was 46,000 cubic feet per day. If the retorts were charged seven times in 24 hours, a greater expenditure would be required in the way of holders or purifiers. To develop the works to their utmost, an expenditure of from £3500 to £4000 would be needed. The Company began to reap the benefit of the capital expenditure upon the works at the commencement of 1894. They were now getting the advantage of the outlay in a more economical production of gas; and they had manufacturing power in reserve ready to meet the expansion for several years to come. The district served was increasing very rapidly. In 1871 the population was 21,000; and in 1891, it had grown to 32,000. A great deal of building was going on in the neighbourhood; and 112 applications for new services had been sent in since the arbitration proceedings commenced in August or September last. As a matter of fact, the sale of gas in 1894 was not equal to that in 1893. This might be attributed, as to half, to the decreased consumption in the public lamps, and to the depression in trade. Iron-works and chemical-works were the largest customers. The mains and pipes in the outside districts were not fully utilized. There were 3214 meters now in use; and the length of mains was nearly 39 miles, about 6 miles of which were duplicated. The pressure over the

district at night was from 20-10ths to 24-10ths. The condition of the mains at the present time was very good. The proportion of unaccounted-for gas was a little less than 20 per cent. This was rather above the average; the reasons being found in the great length of mains, the mineral workings in the Carron district, and the continual disturbance of the roads caused by the erection of new buildings and other works. Another cause might be traced to the imperfect maintenance of the public lamps. These were not very well looked after, and so a question arose between the Company and the Corporation on the matter. It was found that, out of 99 lamps, 44 were leaking. The Company had been systematically setting about methods for remedying these defects, and reducing the leakage, by testing the pipes; and had they been allowed to continue, they would in course of time have put everything right. The public lamps were no part of the property of the Company. The consumption of gas in the lamps was paid for on the average meter system. The illuminating power of the gas was about 23 candles. In 1889, the profits were £2723 10s. 7d.; in 1890, £2741 19s. 10d.; in 1892, £1907 9s. 8d.; in 1893, £3436 1s. 11d.; and in 1894, £4848 13s. 11d. The low result for 1892 was owing to the fact that the working expenses were increased by the alterations; and in that year the price of coal was abnormally high, although the price of gas was not raised for some time. In 1889, the price of gas was 3s. 4d.; in 1890-91, 3s. 9d. Since that time it had been raised to 4s. 2d., with a discount if the amount exceeded a certain sum. He had no doubt that the business of the Company would considerably increase. The value of the undertaking depended entirely upon its earning power. In assessing its value, the basis should be a sum which, when invested in a like security, would give a return equal to the present maintainable revenue. The revenue for 1894 should be the one taken as the basis, with certain modifications. In the first place, part of the works was built upon leasehold land, which stood in the books at £3447. To meet this, a sum of £15 17s. should be set aside annually, and allowed to accumulate at 3 per cent. for 68 years—the unexpired term of the lease. The works, being reconstructed works, did not require much allowance to be made for repairs and maintenance. The actual repairs in 1894 came to 3·38d. per 1000 cubic feet of gas sold. But a fair allowance would be 5d.—thus adding 1·62d.; making a total deduction from the profits under this head of £355 6s. 3d. Then, on the other side, there was an error to be corrected. The Company had been paying £5 a year for the privilege of taking water from the canal; but they could get all they wanted from the Commissioners' pipes, which they paid for in the rates. These deductions from, and the addition of £5 to, the profit of £4848 13s. 11d. for the year 1894, would bring out the sum of £4482 10s. 8d., which he should consider to be a fair maintainable value one year with another. A concern of this character was worth 22·2 years' purchase—*i.e.*, a yield of 4½ per cent., which would amount to £99,595. To this should be added 10 per cent. for forced sale, £1000 for winding-up expenses, and £1000 to be devoted to the compensation of officials; making a total of £111,554.

Cross-examined by Mr. BALFOUR BROWNE: In 1893, 65 per cent. of the gas supplied was consumed in the burgh of Falkirk; but this was not the case in 1894. In some of the streets there were, no doubt, four or five mains. This was incident to the competition that previously existed. The figure of 39 miles of mains which he had given included 2¾ miles belonging to private owners, with whom a bargain had been made that they should lay their own mains.

By Mr. CORBET WOODALL: In some cases, the meters were at the end of these mains, and in others at the beginning.

Cross-examination continued: There had been a decrease in the quantity of gas sold since the amalgamation of the Companies. This was easily accounted for; such a decrease was general all over the country. When small mains had been removed and replaced by larger ones, he had merely given credit for the old materials of the mains, and not altered the capital account by taking out the value of the main; but full effect had been given to this by increasing the maintenance from 3·62d. to 5d. per 1000 cubic feet. The smaller mains which had been lifted were almost always laid down elsewhere. It was not the case that, to light up the East Bridge Street gas-works, and put them into operation, would cost more than the gas would be worth when produced, though it was true that the gasholder there had not been in use for two years, and none of the old retorts had been at work, as the Company had as much producing power as they required at Grahamston. In 1893, the Company gave notice of a Bill for power to acquire further land upon which to erect works, in order to meet the probable extension of business. He did not remember what the estimate for those works was; but it was certainly more than £20,000. There were 90 retorts at the Grahamston works, each of which carbonized, on an average, 2¼ cwt. of coal in four hours. In 1894, they obtained an average of 8440 cubic feet of gas per ton of coal, which was a very low yield. If seven charges were made each day, the yield of gas would be increased by one-sixth; making a total yield of 600,000 cubic feet per day. If there were more charges, they would be able to burn off the charge in a shorter time, as was done elsewhere. As he had said in his examination-in-chief, in order to develop the works to their utmost, a further expenditure of between £3500 and £4000 would be required. Of this sum, from £80 to £100 would be needed for condensers, £900 for scrubbers and washers, £100 for purifiers, and £2500 for gasholders.

By Mr. STEVENSON: At Grahamston they had at present storage room for 348,000 cubic feet.

Cross-examination continued: The further expenditure would be required to be incurred in the next five years. The retorts were arranged in settings of six in each bed; and in midwinter only one set could be standing idle. He was not aware that it was usual in gas-works to have a 10 per cent. margin of retort power in excess; nor did he admit that in their case they only had a margin of 6⅔ per cent. All the buildings were not new. The roofs were of corrugated iron, which was the material of which they were usually made. According to the Company's register, there were 3216 meters in use. In some cases there were two meters to one building; so that the number of meters in the Company's books did not correspond with that of the houses supplied. In 1891, the Corporation tested the gas, and found it worked out at only 19·33 candles; but this was during the railway strike in Scotland. The strike commenced about Christmas, and collapsed on Feb. 15, 1891. The test giving 19·33 candles was made on the 16th of February, and therefore after the strike was over; but the apparatus could not be put into proper working order in so short a time. The strike interfered not only with the supply of coal, but also with the lime used for purifying; and this caused the purifiers to get out of order. The railway system was in a disorganized state for many weeks after the strike. Some of the lime was now brought by water; but this was not the case at the time of the strike—the contracts then being all with the Railway Company. He did not admit that a test made on April 13, 1894, showed only 20·28 candles. He was present at the opening of some of the mains. There might be a little corrosion on a few of them; but really the pipes he saw cut were much better than those put in now. The pipes referred to had, no doubt, been down from the formation of the first Company. Those he saw opened were laid at depths varying from 13½ to 20 inches.

By Mr. STEVENSON: These were the oldest pipes, and probably the best. They were made of Scotch iron.

Cross-examination continued: In the suburban district served by the Company, a very much larger proportion of the roads were, of course, unsuited for heavy traffic, such as traction-engines, than was the case with other companies. Gas-pipes frequently broke under a steam-roller; but when the pipes which were near the surface were laid, there were no steam-rollers in use. Theirs was not the only district where drainage and sewerage works were carried out; but it ought to be taken into account when comparing the quantity of unaccounted-for gas with other places. The bad state of repair of the public lamps, which were formerly not under the control of the Company, would account for a great deal of the wasted gas. Questioned as to the figures he had given as the total profits for the various years, witness said he had taken them from Mr. Lass, to whom he would refer Counsel for particulars, as he was not responsible for them. He had taken the profit of £4848 13s. 11d. for 1894 as the basis of his calculations. In the previous November, the Commissioners gave notice of a Purchase Bill. It would have been better to take a year not disturbed in that way, if one could be obtained; but he did not see that it made any difference.

Mr. BALFOUR BROWNE: Do you know that the real difference between 1893 and 1894 comes in in the smaller amount you were paying for coal in 1894, while you were charging the same exorbitant price for gas.

Witness: I know that the price of coal did fall in that year.

Do you not know that the saving on coal alone amounted to the sum of £1009 13s. 9d.?—I know that the saving was considerable.

Cross-examination continued: He was not aware that, before the amalgamation, the Joint-Stock Company were in the habit of regularly writing off something for depreciation. In the six years since the amalgamation, a sum had been written off under that head on two occasions—viz., 1892 and 1893. Nothing had been allowed for depreciation in 1894, because it was not necessary, nor was it necessary to do it in those years when it was taken off, so long as sufficient money was expended on repairs. No doubt if a thing were repaired as well as possible, there would come a time when it must be renewed; but the figure of 5d. which he had taken, was in excess of what was usually allowed for repairs. The average given in Field's "Analysis" worked out to about 4d.

By Mr. STEVENSON: There was a considerable difference in size between the works in the "Analysis" and theirs; the works dealt with by Mr. Field being much larger.

Cross-examination continued: He did not agree with the following minute of the Directors: "It will be observed that, upon the above new works and plant, sums amounting altogether to £189 13s. have been charged to revenue, as it is considered that 3 per cent. deductions for depreciation may not be sufficient to cover deterioration in all kinds of apparatus." He did not exactly know the meaning of this minute.

Mr. BIDDER: Does it appear what it is 3 per cent. of?

Mr. BALFOUR BROWNE: It is a note in your report of 1880. The note shows what you had expended on repairs and other matters. The 3 per cent. deduction for depreciation had been dealt with in the accounts.

Mr. GRAHAM MURRAY: It is 3 per cent. upon the total standing at the moment it is calculated as profit.

Mr. BALFOUR BROWNE pointed out that the average of a great number of Suburban Gas Companies taken from Field's "Analysis" worked out at 5·99d. per 1000 cubic feet.

Mr. BIDDER: Is that the lot, or merely a selection?

Mr. BALFOUR BROWNE: There are twelve of them; and the average is for the year 1893. Of course, I was only suggesting that in this particular case there should be a great deal more than the 6d. which these Suburban Companies give; and I will tell you why. In the report for 1889, the Directors state: "The double works and the double piping are still being maintained to a considerable extent, and the doing away of this duplication is likely to prove a work of some years, unless at a large public expenditure, which the Directors do not think advisable. Every opportunity, however, is being taken, when streets are being formed, altered, or repaired, to dispense with one of the pipes, and in many cases, where necessary, substituting a large pipe for the two old ones. In the meantime, therefore, this arrangement is a source of extra expenditure, instead of, as it will shortly prove, a great saving." Is it not the fact that, because of having four, five, or six small mains and two sets of works instead of one, repairs ought naturally to be higher than in the case of an ordinary company—should not the repairs be higher than the average?

Witness: I think if I put down the repairs at a little less than double Glasgow, I should not be far wrong.

Do you really think there is any comparison between Falkirk and Glasgow?—I have nearly doubled it.

Is that all you have done? You have allowed double Glasgow, and you think that is fair?—I have also compared with the other Companies that are in Field's "Analysis." I have looked at the whole of the Companies which appear there, and upon a consideration of them I formed my estimate; and I think that 5 per cent. is very fair.

With regard to the cover, as I understand, you say that, because the Falkirk Company have prospects before them, and prospects of making

more money than they did in the past, therefore you took a higher multiple than you would otherwise have done?—And because there is a great deal of dormant capital at the present time.

Then I suppose you call that an unexhausted power of making money?—Yes.

Suppose that was not the case—suppose that the district was going to stand still, and that there was no probability of increase at all—what multiple would you adopt?—Possibly I might take about 20 years' purchase.

Possibly a little less?—Of course, I cannot say until I come to consider the situation; and such a situation is not here.

Cross-examination continued: He had never heard of gas companies being sold at a very much smaller figure than that which he had given. He had taken 22·2 years' purchase on account of the good security the Company had, which warranted him in putting on the extra two years. He did not consider that the price of gas—viz., 4s. 2d.—was high; it was about the average for the whole of Scotland during 1893. He did not think this price would be a sufficient inducement to others to come in to compete. Such competitors would not live very long. The result of competition in Falkirk and elsewhere had generally been amalgamation. Having no statutory powers, the Company could not have prevented others from starting. It was true that their pipes were only in the public streets on sufferance; but they had been there ever since gas was used.

Mr. BALFOUR BROWNE: You think that is so plain as to entitle you to adopt the figure you have?

Witness: I think the circumstances were such as to entitle me to take the multiplier of 22·2. If we had been a statutory company, the multiplier would have been 27 or 28 years. The 10 per cent. for compulsory purchase was added because it was the usual practice.

Can you tell me on whose authority you allow £1000 as compensation for officials?—I cannot give you a specific instance just now. But I have heard of it; and I consider it is the right thing to do.

Upon what basis do you put down £1000?—I consider it is a wrong thing to throw a man out of employment without compensation.

Cross-examination continued: With certain outlays, the Company would be able for a good many years to come to meet the wants of the public with the present works.

Re-examined by Mr. BIDDER: The manufacturing capacity of the works was considerably beyond the present maximum actual output. A sum of £4000, in round figures, would be required for alterations and repairs to utilize the manufacturing capacity. New works would also be wanted. Last year the Company went to Parliament for several objects—one being that they might be constituted a statutory Company, with parliamentary powers, and another to secure a site which, sooner or later, it was felt would be required. Land was being rapidly taken up in Falkirk; and suitable sites were becoming more and more difficult to get. As a matter of fact, the very piece of ground the Company had secured the option of had already been acquired for public works. In the proceedings before Parliament, an abortive attempt was made to get words put into the Act which would have prevented the Company from claiming 10 per cent. in the event of a compulsory sale. With regard to the suggestion that an exorbitant charge was made for gas, it should not be forgotten that the Company were not under any obligation or restriction as to price.

Mr. CORBET WOODALL: With respect to the matter of depreciation, do you know what the practice of Parliament is in regard to incorporated companies?

Witness: I cannot say that I am familiar with it.

With regard to the winding-up expenses, I understood you mentioned a price which you consider should be paid to the shareholders, and which will enable them to re-invest their money so as to receive the same income upon their securities?—That is the principle of my valuation.

That is the amount you would expect to be provided by the purchasers?—Yes; in order that the net sum should be such as to give an equal revenue in the future.

And you assumed £1000 as the cost of that?—Yes.

Mr. BIDDER remarked that, according to his experience, the practice of giving 10 per cent. additional under the Lands Clauses Act was to cover charges in connection with re-investment; and therefore it might be said to cover expenses of winding up. Under these circumstances, he did not think he could maintain that there should be, in addition to the 10 per cent., a separate sum for winding-up expenses.

Mr. CORBET WOODALL: In regard to the proposed purchase of new lands, was it at all in your mind what it might be worth to remove the works because of the greater economies to be effected by the new site in comparison with the existing one?

Witness: It was in our minds at the time.

Then about the practice in regard to the laying of mains. Do I understand that the mains taken up are relaid at the cost of revenue—that the cost of relaying pipes taken out of the ground is put against revenue?—Yes; except in the two particular instances I mentioned. There was a little difference there.

How is that dealt with?—In this Grahamston extension, it was charged to capital. Our practice was generally to put the difference between the old and the new to capital; but sometimes we might not do that very strictly.

Mr. STEVENSON: You say you know a case where 10 per cent. has been given for compensation for disturbance. Can you give us the reference to it?

Witness: I cannot.

There is another thing you might explain. You were a Director, I believe, up till a year or a year and a half ago?—Yes.

Will you tell us what reasons influenced the Directors thus to alter and increase the capital of their works at Grahamston when they had their works at East Bridge Street, and what induced them to throw these works entirely out of use? I presume you know the reason which actuated them?—The chief reasons were that, by improving upon the Grahamston works, we should be better able to manufacture a cheaper gas, and effect economies.

What amount per 1000 cubic feet did you expect to save by doing so?—We did not enter into any such calculation at all.

Have you made any such calculation?—No.

Then it is simply a matter of general knowledge?—Yes.

Do you not think it would have been more reasonable to have continued to use these works at East Bridge Street, instead of abandoning them altogether?—We have not abandoned them altogether.

Instead of abandoning them for so many years. You have abandoned them, as far as operating them has been concerned, for some little time?—We consider it is cheaper to do so, as long as we are able to meet the cost of maintenance.

Do you think that in the future, if these works are brought into operation again, the cost of gas will be cheapened by doing so?—It will make very little difference in that way, as they would only be worked in the dark season of the year.

They would be only lit up for a few weeks during the dark season, if you had continued to operate them?—Yes.

Mr. *W. Black*, examined by Mr. DICKSON, said he had had upwards of 25 years' experience as a civil engineer and architect in Falkirk. He was fairly acquainted with the town, and had prepared cartoons showing the mains belonging to the Company. He had also, in conjunction with Mr. Cowan, prepared a table showing the lengths and sizes of the pipes. He had examined the pipes at several places, and found them in good order. He had also prepared plans of the works and buildings belonging to the Company, and a schedule containing a detailed description thereof. The condition of the buildings and erections belonging to the Company was fairly good; and they were suitable for the purpose for which they were used. There were now 263 new buildings being put up in the district. The total number of dwelling-houses was 5925. Ten new shops were in course of construction; and a new ironfoundry had just been completed within the burgh which was capable of employing about 200 men. These works would consume a considerable quantity of gas. He had also prepared plans for another ironfoundry, to be erected close to the burgh boundary within the gas district, which would stand upon 12 acres of ground. The general trade of the town at present was very good. He had examined the property belonging to the Company, with a view to fixing the value of it. The total rental of the dwelling-houses in East Bridge Street he fixed at £64 15s., from which had to be deducted the feu duty of £2 7s. 4d.; leaving a net total of £62 7s. 8d. The value he put upon these houses was £750, which was a fair and reasonable figure. The Bankside property he valued at £300, which was reasonable, considering the present condition of the houses. The total valuation for the dwelling-houses belonging to the Company was £1050.

Cross-examined by Mr. BALFOUR BROWNE: He had inspected the pipes at many places; and he could not say they were in a bad condition. The metal was of fairly good quality. The pipes were not in several places nearly eaten through. The houses in East Bridge Street were not dilapidated, although they were old. He could not say whether or not they had been freshly painted before he saw them. As trade had been good all through 1894, the falling off in the consumption of gas could not be put down to this cause.

Re-examined: A coal strike occurred in 1894, which lasted close upon four months; and this seriously affected all public works, especially in and about Falkirk. Practically there was no supply of coal to be had for public works.

Mr. *A. Wright*, examined by Mr. CRABB WATT, said he was foreman of the meter department of the Greenock Gas Commissioners. He had inspected the meters belonging to the Falkirk Joint-Stock Gas Company. There were 919 of them, and 80 in private ownership, all of which had been made by good makers, and were suitable to the work expected and required of them. They were quite fit for work for many years to come, being all in good order. So far as he had examined them, they appeared to be in conformity with the Company's survey books. The majority of the meters had been made with cast-iron cases; whereas the usual substance employed was tin-plate. Being made of cast iron, they would be more durable, as they could be more cheaply repaired.

Cross-examined: The life of a meter varied; it depended upon its quality. The majority of the meters owned by the Company were wet ones, which lasted longer than dry meters. He had some meters which had been in use for the last 50 years. The fair life for a dry meter was about 20 years.

Wednesday, Dec. 19.

To-day further evidence was given.

Mr. *Alfred Lass*, F.C.A., examined by Mr. BIDDER, said he had been instructed by the Company to inspect their accounts, and prepare analyses for use in the arbitration. He had no knowledge of his own of the agreements of sale and amalgamation of Sept. 17, 1887, by which the Lighting Company's undertaking was sold to the Joint-Stock Company; but he had read them, and had examined the award of the Arbitrators, which started the Amalgamated Company. This award he had taken as the starting-point in the examination of the accounts. The amount of the award was £13,500. Included in this was a sum of £189 5s. 3d. for the value of the stocks, which left £13,310 14s. 9d. as the amount for the undertaking. The total of the Joint-Stock Company's award was £23,539 8s. 1d.; and included therein was £411 0s. 6d. for the value of the stocks, which left £23,128 7s. 7d. as the value of that Company's undertaking. The total value of the two undertakings was £36,439 2s. 4d. To represent this, 18,219 shares at £2 each fully paid, amounting to £36,438, were issued to the shareholders of the two Companies. Starting from that point, he had examined the accounts year by year, had carefully analyzed them, and had tabulated the analyses. The accounts of the Company differed somewhat in form from those usually adopted by gas companies. He had rearranged them, so as to make them as nearly as possible agree with the standard form of accounts. The financial year had always been made to end on the 15th of May; but there was a broken period in the first place from January to May. The amalgamation taking place as from the 15th of January, there were four months of a broken period. His account represented the position of affairs at the date of the amalgamation on Jan. 15, 1888. The value of the assets was that mentioned in the award. During the broken period of four months from Jan. 15 to May 15, the profits upon the working amounted to £1098. In 1888-9, the profit and loss

account showed a profit of £2723 10s. 7d. On capital account £306 was spent, and £91 on new meters; and, of course, there were amalgamation expenses, which were not an addition to the buildings. For the next year, ending May 15, 1890, £377 was expended on capital account, and £131 for new meters; the net profit amounting to £2940 13s. 4d. In that year, an additional 3039 shares were issued to meet capital expenditure. For the year ending May 15, 1891, the capital account showed a large expenditure for reconstruction and reorganization. The profit for that year came to £2741 19s. 10d. For the year ending May 15, 1892, the capital expenditure on the works amounted to £5295 16s. 1d., besides £147 on meters; leaving a net profit of £1907 9s. 8d. In the year to May 15, 1893, the capital expenditure was £3204 11s. 11d., and £153 for meters; leaving a profit of £3436 1s. 11d. For the year ending May 15, 1894, the capital expenditure was £535 18s. 5d.; the amount spent for meters, £76 7s. 1d.; and the profit, £4848 13s. 11d. In 1892, there was a further issue of 3543 shares; and in 1894 an issue of 199 shares—the capital account being overdrawn by £1153. In the accounts of the Company, the Directors' fees were not charged against working expenses, but against any profits available for division. There was some portion of the net revenue account not included in the accounts representing the dividend, and the amount paid to the Directors; and these were things that must be kept in view, so as to enable one to understand the accounts.

Mr. Corbet Woodall: If they are not in the account, what becomes of these items?

Witness: They do not appear in the Company's accounts at all. A sum of £2818 3s. 4d. is shown as carried forward, when there should only have been brought forward a sum of £300 16s. 1d.; the difference being the dividend and the Directors' fees.

Examination continued: He had corrected the accounts in order to make the statements in accordance with the usual view of what was chargeable or not strictly chargeable against working accounts. Taking it year by year, and beginning with the year ending May 15, 1889, the Company's account showed a profit of £2609 2s. 3d. as the profit for the year. To this he had added £62 2s. 4d. for income-tax. This was not a charge against revenue, but against profit and loss, under the head of taxes and public burdens. He had also added the interest on temporary loans, £52 6s., which was not a charge against revenue, but against profit and loss. After making these corrections, the working profit appeared to be £2723 10s. 7d. For the year ending May 15, 1890, the accounts showed a profit of £2925 2s. 5d. He had made corresponding corrections in respect of income-tax and temporary interest in that year, amounting to £99 16s. 7d., which increased the profit to £3025 6s. On the other hand, he charged against working account certain sums which ought to have been charged, and had credited items which ought to have been credited. For instance, the first amount was interest received on deposits, £39 17s. 8d.; and in the same way, interest paid on loans was not the business of the working account. Interest gained by a deposit in the bank was not credited to the Company, as it was not part of the working of the concern. Another item was the premium on 130 shares which had been sold, and which, not being part of the produce of the working for the year, must be taken out. The Directors' fees ought to have been charged to working account, making the profit less. Deducting these items, amounting together to £84 12s. 8d., he arrived at a net sum of £2940 13s. 4d. Exactly the same thing had been done with the next year (1891); resulting in the profit of £2658 13s. 3d. being changed into £2741 19s. 10d. For the year 1892, he had corrected the profit of £1735 10s. 1d. to £1907 9s. 8d.; and in 1893, the profit of £3350 11s. 10d. became £3436 1s. 1d. For the year 1894, the profit of £4774 2s. 7d. should be £4848 13s. 11d. He had prepared different statements showing the net results of the past six years' working, the details of the capital, the quantity of gas produced and sold to the private consumers and to the public lamps, and the quantity unaccounted for. He had also, in one of the tables, shown the quantity of gas made and sold per ton of coal carbonized, &c. In 1889, the gas sold was 40,523,000 cubic feet; and in 1894, it was 52,639,300 cubic feet—being an annual increase of 5·37 per cent. The accounts for the last twelve months showed a slight check in the advance, and a diminution in quantity by 1,300,000 cubic feet, which was owing to depression in trade and the bright summer. Had it not been for this, the percentage increase would have been considerably greater. The decrease in private consumption was 518,000 cubic feet; and in the public lamps, 778,700 cubic feet—making a total of 1,296,700 feet. In 1894, the gas made per ton of coal carbonized was 8440 cubic feet; and 6620 cubic feet was the net quantity sold. In the year 1892, the figures were 7520 cubic feet of gas made, and 5999 cubic feet sold. There was a great improvement in the residual products in 1894; the percentage of coke used for fuel being 38. He should like to say, with reference to this, that the cannel coal and the shale coal had not produced any coke. The splint coal which had been carbonized had produced the whole of the coke used and sold. During the years 1891-2-3, the price of coal fluctuated considerably. Had the cost for coal in 1894 been the same as in 1893, there would have been an addition of £884. For the latter year, there was also a gain on coke of £97. This was not due to any better price being obtained for coke, but to the reduced consumption in the new retorts. On tar and liquor there was also a gain of about £269. The net result was that for coal the cost of gas per 1000 cubic feet was 17d. in 1893, and 11d. in 1894. There was a certain saving in purifying charges, due to better apparatus. There had also been a reduction in labour by the introduction of more modern plant.

Cross-examined by Mr. Balfour Browne: The figures he had put in his balance-sheet had practically been abstracted from the Company's accounts. The tables merely showed the alterations which he had made in the accounts. These alterations were not of very great moment; it was simply a question of principle. Witness was cross-examined at considerable length upon the various items in his tables, and was also referred to some remarks in a paper read by him before the Chartered Accountants' Students' Society as to the importance of keeping gas-works at all times in a thoroughly efficient state of repair—the cost being charged to revenue account; and also with regard to the cost of renewals and depreciations which he had stated should be met either out of the profits of the year, or by setting aside a certain sum to accumulate at compound interest to meet the renewals as they fell due. Witness said he quite agreed with every statement he had previously made.

Mr. Balfour Browne: Do you agree with the following statement: "Plant and machinery may be repaired; but these repairs will not provide for the imperceptible depreciation or lessening of value which is going on day by day, and which is only made good when the thing depreciated is renewed or restored to its first original state. Take, for instance, a gasholder. It may be repaired as often as possible; but it cannot be kept in such a state from year to year, or at the expiration of its term of life, as to be as good as new. Therefore the gasholder must eventually be renewed by a new one being erected in its place"?

Witness: Yes.

Further on you say: "Thus, whichever mode be adopted, the result will be that the works which originally cost £130,000 will be, at the end of 100 years, of the same size and capacity, and structurally as good, as when first erected, and of equal value. In large cities and towns where the population is continually increasing, it becomes necessary from time to time, in order to keep pace with the manufacture of gas, to enlarge the works; and as the works are enlarged, the renewals of the enlarged portions thereof will from time to time have to be provided for. Therefore, if 1¼ per cent. upon the total amount expended on the works at the end of each year be yearly taken out of the profits, and allowed to accumulate at compound interest at 3 per cent. per annum, it will at all times (assuming the length of life of each portion of the plant, buildings, and apparatus be taken as above) produce a fund sufficient for the renewal of the works in perpetuity, whatever their size and capacity, once during the average period of life, which, for all practical purposes, may be taken at from 37 to 40 years." Do you still agree with that?—Yes.

You had a sum of £51,000, roughly speaking, as the proper amount of this Company, according to the accounts?—Yes.

And 1¼ per cent. on that works out at what?—£678.

If 1¼ per cent. is right, the 3·38d. which I find in your tables as the cost of repairs and maintenance ought to have something added for renewals?—There certainly ought to be something added.

And you think that 1¼ per cent. is right?—Well, it comes out at about that, taking the life of a gas-works as I said there, and assuming everything to go on in the usual way.

That is moderate, you say?—I think it is somewhere about it. Probably 5d. would be a proper amount to allow for repairs, maintenance, and renewal of works and mains.

Mr. Bidder: Would that include depreciation?

Witness: It includes renewals, which is the same thing as depreciation.

Mr. Corbet Woodall: You say it does not include depreciation.

Witness: Repairs, maintenance, and renewals. It does not include depreciation as renewals; but it comes in as renewals.

But there is nothing left for depreciation?—That is what I said.

Mr. *R. C. Millar*, a chartered accountant, in reply to Mr. Crabb Watt, said he had had large experience in arbitrations for fixing the values of mercantile businesses, and had also discharged the duties of arbitrator and accountant-assessor. He had made a detailed examination of the books and accounts of the Company, and especially of the accounts extending from the date of the amalgamation to the present time. He had also examined the statements put in by Mr. Lass, and concurred with him in all particulars. He had independently checked these statements, and found them substantially correct. The accounts as submitted to the shareholders fairly represented the condition of the Company, and accurately set forth the profits earned in each year. The income-tax should be added to the profit shown; and the interest paid, less the interest received, should be added to the profit. Income-tax was a variable quantity, and might disappear altogether. This was a circumstance to be taken into account. The improvement in the profits for 1894 was mainly attributable to economy in wages and fuel, owing to the greater efficiency of the works, to the fall in the price of coal, and to an increase in the sum realized for residuals.

Cross-examined by Mr. Graham Murray: He had never had any experience in valuing gas-works. His experience as a judicial factor had once extended to a gas-meter works; and he had to go all over England about it. He did not know there was any legal limit to the price the Company could charge for gas.

(*To be continued.*)

CHRISTMAS TIME AT THE YORK GAS-WORKS.

On Saturday, the 22nd ult., Mr. Charles Sellers, the Engineer and Secretary of the York United Gas Company, delivered his usual Christmas address to the workmen. It was as follows:—

Let me again have the pleasure of wishing you all "A Merry Christmas and a Happy New Year." It is true that this is an old custom; but let us not despise customs on account of age. Christmas wishes are home wishes which nestle round the old arm-chair in which our fathers sat; and they are wishes which may be heard in the music of the old, old song, "Home, Sweet Home," which links the happy memories of youth with old age, and carries us back to the days "when we were boys together"—

> "When life seemed formed of sunny years,
> When all that we then knew of care
> Was washed away in silent tears,"

and when our faith in wishes seemed so beautifully realized. But now, with the sunny years of youth in the background, we find that happiness is not a matter of wishing, but of works. There is no royal road to happiness, as there is no royal road to learning. As a man makes his bed, so he must lie upon it; and, odd as it may appear, a plank bed is just as natural an outcome of conduct as is a feather bed. There is no mystery about it. Conduct is as certain in its action as is a principle in mechanics or as a rule-of-three sum; and therefore it is useless our wishing for a soft bed or a happy new year if we do not prepare for them by industry, sobriety, and thrift.

In fact, we must follow the example of the American preacher who wanted to cross a river, and when he got there the ferry-boat was gone. Instead of whining, and wishing himself across, he rolled up his breeches and waded over. And such a man, you may rely upon it, will always have a soft bed, as he will always have a happy new year.

But the methods for realizing Christmas wishes are such a bundle of contradictions, that it is, perhaps, just worth while to review a few of them. Nations, at Christmas, like individuals, preach "peace on earth and goodwill toward men." But no sooner is Christmas turned than nations increase their war machinery, and prepare in their spring budgets for an ever-increasing cost to "vanquish and overcome their enemies." And in this way we find the same contradictions in individuals, in the conduct they follow to bring about the blessings they profess to plead for in that fine old wish for a merry Christmas and a happy new year.

First, we have the man who commemorates the birth of the Prince of Peace by getting drunk and declaring war against his neighbour; and this is the way, as is shown in our Law Courts, that thousands in Christian England endeavour to realize their ideas of a merry Christmas. Secondly, we have the man who prepares for a happy new year by thriftlessness and getting into debt—conditions which are quite in harmony with anxieties and plank beds, but which never can bring a happy new year. Thirdly, we have the ambitious man, who makes haste to be rich, and who thinks he can avoid entering into the proverbial snares which wily spiders set for him on the race-course, in trade, and on the Stock Exchange. But with all the certainty which follows the fly that enters the spider's parlour, the man who makes haste to be rich by gambling gets caught, and his happy new year gets spoilt. It is true there are various kinds of flies. There is the respectable fly who—

> "Compounds for sins he is inclined to
> By damning those he has no mind to;"

who, while he will gamble in trade and finance, will not touch a race-horse with his little finger. Then there is the highly moral fly, who will gamble on the Stock Exchange, but who will not hesitate with another fly to "run him in" for playing at pitch and toss for coppers. Then, again, there is the fly who is not content to live within his means. This individual will often look down scornfully upon a conventional gambler, while he, by living upon, and risking, other people's money, is as morally a gambler, and is as likely to be caught in the snares into which men enter who make haste to be rich, as the Stock Exchange or horse-racing gambler—

> "For all men, till by losing rendered sager,
> Will back their own opinions with a wager."

But in all gambling, as the spider lives upon the fly and makes his own snares, the fly will always get the worst of it, and the spider will always get the happy new years.

But we must not lose our heads in condemning speculation, for it was speculation, closely akin to gambling, which went neck or nothing in its attempt to lay a cable across the Atlantic Ocean, wherein the first and second lot of adventurers—gamblers, if you like—lost all their money, while, finally, out of the gamble came one of the greatest blessings to humanity. And through the success of this speculation, nations are now linked together by electric bands, which, like a nervous system, cover the earth as the waters cover the seas. Neither, if we do not gamble, should we presume to be the "salt of the earth," any more than Georgey Barnwell—

> "Who always stayed at home on Sundays,
> 'Cause his master wouldn't let him out"—

should presume to be the best of boys.

Another method—strongly recommended—for ensuring a happy new year is to get married. But this method is not what you would call a "dead certainty." A marriage means a home, and to have a home means that you must provide happy conditions, otherwise the home of a bachelor, who is maid-of-all-work, and has to sew on his own buttons, may be preferable. It is true that a man must ask his wife if he is to live. And happy is the man whose wife can make a shilling go as far as an ordinary eighteenpence; for that is the woman to make a happy new year. Happy also is the man whose wife will banish the gin-bottle from her household—the bottle which, in these modern days, in the hands of woman, saps the foundations of so many homes. For it is the woman more than the man who writes upon the first clean pages of our history, and to whom, more than to the man, is addressed the lines—

> "Just as the twig is bent the tree's inclined."

If you rely, then, upon these conditions for building up a happy home and a happy new year, you will not be disappointed.

Upon our own business of gas making little need be said. Our old competitors—oil gas and water gas—have retired from the field; while the electric light is bowing its head before the inroad now being made by the improved gas-burners which science has recently put into our hands. As a younger sister, the electric light may be acknowledged; but she will have to be far more modest and less expensive in her requirements before she can hope to take part in the merry Christmas and happy new year which we, as gas men, are about to enjoy.

Mr. Sellers then paid the men a high compliment, and said that for sobriety he would match them against any similar staff of men in the country; that during the year he had only been troubled with one man, who had marred the completeness of the compliment; and that he hoped the day would come when workmen would kick such discreditable exceptions out of their ranks. He afterwards presented the usual Christmas gifts of books, toys, and useful articles for the men's children; and, to keep alive the memory of his mother, he distributed twelve Christmas cakes among a similar number of men who had the largest families—a custom Mrs. Sellers practised in her lifetime.

The usual vote of thanks to the Directors for their contributions to the gift fund was passed; and three cheers were given to Mr. Sellers for his address.

ELECTRIC LIGHTING NOTES.

The dangers attending electric lighting were further exemplified last Saturday night, when an explosion occurred in the Euston Road. According to reports which have reached us, the paving-stones for some 30 yards not far from Endsleigh Gardens were forced up, and many of them smashed to pieces. Running under the pavement on the south side of the road are a gas-main and an electric light culvert; the two being about 18 inches apart. The main is one of The Gaslight and Coke Company's, and the culvert is owned and controlled by the St. Pancras Vestry. It was found that, simultaneously with the report, the paving-stones for about 30 yards heaved up and down, and then were forced up a few feet, while fragments flew into the air. The electric light department of the Vestry and the officials of the Company were communicated with; and one of the latter speedily attended with a gang of men who commenced investigations. The broken slabs were removed, and the men dug down to the gas-main. This was found to be entirely uninjured. The presence of any coal gas was not discovered; but the men stated that in the culvert there was a quantity of sewer gas. In the opinion of the Company's officials, it was this which caused the explosion. Two pedestrians who were passing at the time were injured, and had to be conveyed to the University College Hospital, where their injuries were dressed; and then they were allowed to go home.

Unlike most other Corporations who have undertaken the supply of electricity, the Brighton Town Council, on starting their electric lighting works, did not commence by lighting the streets. Now, however, they think the time has come when the ratepayers should receive "some benefit;" and the streets should be "considerably better lighted than they are to-day." They have therefore decided to ask the Local Government Board for sanction to borrow £5200, for a period of 25 years, for the purpose of lighting some of the leading thoroughfares—including Queen's Road, West Street, Western Road, North Street, East Street, and Preston Street. It is proposed that arc lamps shall be employed, partly fixed on standards, and partly suspended from light arches erected across the narrow streets. The capital outlay is estimated at the figure already mentioned—£5200; the annual cost of the light and the capital charges being £2660, as compared with £1874 paid by the Corporation for gas and attendance. Mr. Stafford, the Chairman of the Lighting Committee, hopes that what they now propose doing will be but "the commencement of what will be continued, through the reduction in the price of the electricity, until every alley and street in the town, and every householder also, has been supplied."

Contrary to the policy of the Gas Committee, the Electric Lighting Committee of the Coventry City Council have decided to make a reduced charge for electrical energy supplied for purposes other than lighting—viz., 4d. per Board of Trade unit.

Last Thursday afternoon, at Eden Grove, Holloway, the foundation stone was laid of the central station of the Islington Vestry for the supply of electricity for lighting purposes under a Provisional Order obtained in 1893. The site adjoins the Great Northern Railway, and the land was purchased from the Railway Company at a cost of about £9000. The station is to cost £18,000; and the machinery and plant, including the mains and conduits and public lamps in the compulsory area, will come to £33,000 more.

News of further trouble reaches us in connection with the electric lighting of Londonderry. On the night of the 26th ult., the greater portion of the city was in total darkness until six o'clock, owing, it is stated, to some connection having been omitted; and the citizens had to grope their way about the crowded streets. A local paper pertinently asks: "When is there to be an end of these mishaps? Are they ever to cease, or are we to regard them as inseparable from street lighting by electricity?" Commenting on the undertaking, the paper remarks: "It is not as if the system cost the citizens nothing. We have already pointed out that the maintenance of it must of necessity paralyze the Corporation finances, and starve the other departments of civic administration for many a year to come. The light was to save the citizens £218 a year—so those who, in the face of reason and argument forced it upon a too quiescent and confiding Corporation promised. But now, instead of a profit of £218 or of a farthing, a loss of nearly £3000 a year is tacitly admitted. According to the calculation in Mr. Christie's report—a calculation not based upon practice, but theory—the actual working is to cost about £400 a year more than gas. To this must be added nearly £500 which is still payable to the Gas Company for lighting the back streets; also £1250 for the annual instalments of loans, besides £100 for rent and taxes. And, even when these additions have been made, nothing is allowed for depreciation of plant, which experts put down at £1000 a year. The electric toy is therefore an expensive one. It should be perfect at the price. We fear the verdict of the citizens is that it is highly imperfect."

The St. Ives Corporation Gas Undertaking.—The St. Ives Corporation Gas Committee have arranged with Mr. J. W. Buckley, of Falmouth, to fill the position of clerk of the works and gas engineer during the extension of the gas-works. They have also decided that the maximum charge for gas for lighting purposes shall be 6s. 3d. per 1000 cubic feet, and for heating and cooking 5s. per 1000 cubic feet.

An Improved Water Supply for Pudsey.—At a special meeting of the Pudsey Local Board last Thursday, the Chairman of the Water Committee (Mr. S. Myers) reported that he had had an interview with the Chairman and Vice-Chairman of the Bradford Corporation Water Committee and their Engineer (Mr. J. Watson). He was informed that the Committee agreed to comply with the request of the Local Board that they should lay a new and larger water-main from Bradford Moor to Hill Foot, Pudsey. They were ready to take the work in hand as soon as the Board were prepared to carry the mains forward into the town. Mr. Myers said this alteration would not only give the town a much better supply of water, but would save £150 a year in pumping. The Board decided to do their share of the work, at an estimated outlay of £685.

THE LONDON COUNTY COUNCIL AND THE WATER COMPANIES' UNDERTAKINGS.

The Transfer Bills.

In accordance with the Standing Orders of Parliament, the eight Bills promoted by the London County Council for the acquisition of the undertakings of the Metropolitan Water Companies were deposited in the Private Bill Office on the 21st ult. They are very similar in character; and the following outline of the Bill dealing with the New River Company will give an indication of the scope of the rest.

The preamble of the Bill sets forth the Acts which govern the Company's supply and the districts included within their limits. The East London and West Middlesex Water Companies have powers of supply in parts of the New River Company's district. The preamble states on this matter that "the rates of charge which the East London Company are authorized to demand are higher than those authorized in the case of the New River Company, while the East London Company do not supply water up to the same height as the New River Company are required to supply it, and the rates of charge which the West Middlesex Company can demand are considerably less than those of the New River Company;" that "the New River Company are supplying water within a portion only of their district, and the East London Company are supplying within part of the New River Company's district at higher rates of charge to the consumer; and the New River Company are also supplying within part of the West Middlesex Company's district at higher rates of charge than the West Middlesex Company would be authorized to make." The preamble then goes on to show how the capital of the Company is made up and of what the undertaking consists, and the expediency of its transfer to the County Council.

Passing over the interpretation clause and the provisions for the amendment of Acts, we come to the part of the Bill dealing with the transfer. It is specified that this is to take place on Dec. 31, 1895, or such other date as may be agreed upon; that the transfer may be by agreement as to terms, or, failing agreement, "on such fair and reasonable terms, having regard to all the circumstances of the case, as may be determined by arbitration." The Arbitrators are to be chosen one by each of the parties; and they may, if necessary, appoint an Umpire, or "any engineer, barrister, solicitor, surveyor, accountant, or other person having special knowledge of any of the matters" referred to arbitration, to act as Assessor. In determining the fair and reasonable value of the undertaking, the Arbitrators are to have regard to the following matters:—

The condition and state of repair of the reservoirs, filter-beds, filtration arrangements, wells, mains, conduits, pipes, machinery, and plant of the Company, and the probability of future expenditure thereon, together with any liabilities or obligations in connection with the water undertaking which the Company may reasonably be required or expected to incur. The legal powers of the New River Company to take water, and the probability of such powers being limited. The adequacy and efficiency of the present sources of supply, and of the reservoirs, filter-beds, filtration arrangements, wells, mains, conduits, pipes, machinery, and plant of the Company to meet present and future requirements. The probable necessity of the future introduction of a new source of supply, or new and improved works. The legality of the charges now made or claimed to be made by the Company, together with the circumstances under which such powers of charge have been granted by Parliament. The deductions from any compensation claimed by the Company which may, in the opinion of the Arbitrators, be reasonably made in respect of any insufficiency of the present storage or filtration of the Company, or in respect of the provision of supplementary supplies. The deductions to be made in respect of works, plant, or appliances which have become wholly or partially useless, and the adjustment of the revenue account of the Company in respect of repairs and renewals properly chargeable thereto. The statutory powers of any other company to compete in any other part of the New River Company's district, and the rights of any other company or body to supply water in the Company's district, whether as now existing under statute or otherwise, or as may be likely to exist in the future. The effect of the amendment of the New River Company's Act of 1852, and the incorporation of section 35 of the Water-Works Clauses Act, 1847, with the New River Company's Acts.

No allowance is to be made in respect of any claim by the Company to divide profits in respect of back dividends, or of any assumed future increase of the rateable value other than an increase due to alterations or additions involving increased supply of water; and no addition is to be made to the fair and reasonable value of the undertaking in respect of compulsory sale. It is also provided that if the Council so require, the consideration to be paid for the transfer should be in the form of a half-yearly or other periodical payment charged upon the county fund for a period of not less than 80 or more than 100 years.

The next division of the Bill contains provisions incidental to the transfer—including power to the Council to inspect the accounts and works of the Company. The final divisions provide that the officers of the Company are to become the officers of the Council; and in case any office is abolished, the existing occupant is to be compensated. Provision is also made for the supply of water in districts outside London, and for selling portions of the works to any other local authority.

The remaining Bills differ from the one summarized above in the omission of the provision with respect to the consideration being paid half yearly over a period of 80 to 100 years.

LANCASTER CORPORATION WATER SUPPLY.

The Blea Tarn Reservoir—The Borrowing Powers of the Department.

An inquiry has been held at Lancaster by two Inspectors of the Local Government Board—Colonel J. O. Hasted, R.E., and Mr. E. P. Burd—regarding the application of the Corporation for a Provisional Order, to alter or amend the Local Acts and Provisional Orders relating to the water undertaking, so as to enable them to extend the existing works by the construction of a storage reservoir at Blea Tarn; to legalize the borrowing of £10,000 which has been raised by the Corporation for water-works purposes, under the Order of 1886, without the sanction of the Local Government Board being first obtained; and to make provision for the repayment, by sinking funds or otherwise, of the whole of the debt of the Corporation outstanding or authorized under the Local Acts or Orders, other than the debt represented by stock issued under Part 5 of the Public Health Acts Amendment Act, 1890.

The Town Clerk (Mr. W. O. Roper), on behalf of the Corporation, stated that the original Act relating to the water supply was obtained in 1852, under which a line of pipes was run to the Grisedale springs, above Abbeystead. By that Act they were limited to 300,000 gallons per day, procured by tapping certain springs below the surface of the ground, and bringing the water in pot and iron pipes by gravitation direct to the town. In 1864, further powers of supply were obtained; and under that Act of Parliament, the same line was continued—the additional quantity of water authorized to be taken being 400,000 gallons per day. An agreement was also entered into by the Corporation for the supply of 300,000 gallons of water per day to Morecambe. The next Act was in 1876, when powers were obtained to take an extra 1,300,000 gallons, by means of a line of pipes laid at a lower level than the previous line, taking in water from springs and also from the head waters of the River Wyre. Under the same Act, the district of supply was enlarged by the inclusion of Quernmore, Bulk, and Slyne-with-Hest. The total quantity of water authorized to be taken under these Acts was 2,000,000 gallons per day. The Damas Gill reservoir was constructed under the Act of 1876; and the Abbeystead reservoir under the Act of 1852, and enlarged under the Acts of 1864 and 1876. Having, therefore, power to take 2,000,000 gallons of water per day, with a storage of only 30,000,000 gallons at Damas Gill, the Corporation had found it difficult to maintain a constant supply to the town; and in the face of several applications for additional supplies from various parts of the district, they had come to the conclusion that it was desirable to extend the storage capacity. For this purpose, it had been suggested that a new line of pipes should be laid from the existing 15-inch main on the principal line of supply, along the road to Blea Tarn, where a reservoir should be constructed to hold about 120 million gallons, and that the water from the reservoir should be conveyed by mains through certain enclosed lands, and thence along the high road to Lancaster. As regards the amount expended upon the undertaking, and the estimated expenditure upon the Blea Tarn reservoir, under the Acts of 1852 and 1855 the Corporation had spent £34,058; under the Act of 1864, £9725; under the Act of 1876, £50,000; under the Act of 1880, £15,000; under the Provisional Order of 1886, £10,000; and the balance laid out upon the works was £13,791—making a total of £132,574. The profits of the department more than covered the interest and sinking fund upon the outlay which had been made. In regard to further expenditure, it was estimated that the reservoir at Blea Tarn would cost £61,484, including the outlay on the mains to and from the reservoir, purchase of the site, cost of construction, and contingencies.

Mr. *James Mansergh*, Consulting Engineer to the Corporation, said he was engaged in the survey of the water supply scheme of 1852 (although comparatively a boy at the time); and he carried out the scheme of 1876. He had considered Blea Tarn as a site for a reservoir. It was discussed in 1875, but was abandoned for the time in favour of Damas Gill, which could be carried out at less cost. It was now, however, necessary to provide additional storage. He considered that Blea Tarn was near enough to the town to serve the purpose not merely of a storage, but of a service reservoir. The elevation enabled a good pressure to be given; and the top water was to be 8 feet higher than the existing service reservoir. Gauges had been connected with the springs on the gathering-ground; and he had particulars from 1891. In that year there were 155 days when the yield averaged about 1,560,000 gallons; and as at that time the demand for water would not probably exceed 1,500,000 gallons per day, there was a surplus in that year of 100 million gallons. In 1892, the surplus was about 130 million gallons; and in the very dry year of 1893, the surplus would probably be about 80 million gallons, although during a considerable length of time in the dry period of the year, the town was necessarily put upon "short commons," because the yield did not supply the demand. The provision of Blea Tarn would enable the surplus, instead of being wasted, to be stored, and so used to supply the town. Mr. Mansergh also intimated that there would probably come a time when the limit of 2,000,000 gallons per day would have to be removed, and when it would be necessary to take water from other sources.

Mr. *John Cook*, the Borough Engineer, deposed that for the last five years he had been fully acquainted with the water undertaking of the Corporation and the requirements of the town. The population of the district of supply in 1881 (including 5000 summer visitors at Morecambe) was 34,697; and in 1891, 44,419. In 1894 the estimated population was 50,000. Taking this as the population, the estimated quantity of water required was 1,556,000 gallons per day. Morecambe was supplied by meter; the average being 261,000 gallons per day. The Corporation had arranged to supply the township of Slyne-with-Hest; they had also extended the mains to the extreme boundary of the township of Scotforth; and they had received an application from Morecambe for an increase in their supply of 300,000 gallons. The lowest yield of water in the dry season of last year was 1,127,450 gallons. At the commencement of the dry season, the Damas Gill reservoir was full; containing 30 million gallons. Notwithstanding this, they had to cut off the water supply to the town at nights on 33 occasions in 64 days, which gave rise to considerable inconvenience and loss. It was to prevent a recurrence of such a state of things, that the Corporation wished to construct a new reservoir. The Blea Tarn reservoir would contain 120 million gallons; the area of the top water would be 32 acres, and the depth 45 feet. The reservoir would be basin shaped; and the bank would not be 45 feet, but only about 20 feet. The site had been thoroughly surveyed, and a number of trial holes sunk; the result showing that there was a good clay bottom.

The Inspectors then proceeded to consider the application to legalize the borrowing of £10,000, expended, under the Provisional Order of 1886, without the sanction of the Local Government Board.

The Town Clerk said the £10,000 was part of the expenditure upon the water-works. A Local Government Board inquiry was held at the time, he believed, by Mr. S. Smith, and the Provisional Order

was sanctioned; but the money was borrowed and spent without the permission of the Local Government Board. He presumed that it was thought the Order sanctioned the expenditure of the money without the authority of the Board; and the application for their approval was overlooked. The money was spent; and the borrowing powers under the Acts of 1876 and 1880 had been exceeded.

The portion of the proceedings in regard to the provision for the repayment of the debt of the Corporation other than the debt represented by stock recently issued was purely formal.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The year 1894 will have expired before these "Notes" are published. It has decidedly been a year very favourable to gas-works, so far as dependent upon the management of the owners of them. There is only one break in the line of satisfaction which gas managers must feel at this season, when looking back upon the past year; and that is in connection with the strike of miners, which, lasting over 16 weeks, gave a great deal of trouble to them, and raised the price of coal. This circumstance will affect profits when the financial year closes; but except in so far as coming events cast their shadows before, it should not in the meantime damp the satisfaction which is derived, in nearly every case, from the contemplation of increased businesses and lower prices.

Several public questions relating to gas supply have been under consideration. The most important was the transfer of the undertaking of the Falkirk Joint-Stock Gas Company to the Corporation, which is just about to take place. This subject is so recent that nothing more need be said of it, except that it has been a stubborn contest, converted almost into a bitter one by the litigious spirit displayed by the representatives of the Corporation, and which has resulted in nothing except the spending of money.

Next in importance has been the extinction of the Dundee Gas Commission, and the transfer of their powers to the Town Council. The Commission was curiously constituted; there being representatives, to the extent of about one-third of the whole number, of outside, non-elective, and in some cases obsolete bodies. These have all been removed; and the management of the important gas undertaking of the city is now in the hands of the direct representatives of the ratepayers. The change is not likely to have any effect on the management of the works, which all acknowledge to have been excellent; but the new arrangement looks more logical, and fits in better with modern ideas of the conducting of public business. The change was, in the initial stages of the proposal, threatened with opposition; but by the exercise of tact, the measure passed through Parliament unopposed.

During the year an important question was raised at Lockerbie, where, to make up a deficit in the accounts of the Corporation gas undertaking, the Police Commissioners imposed a gas guarantee rate. Several ratepayers objected to their doing so; and it looked as if a legal decision as to the time when a corporation owning gas-works are entitled to impose such a rate would be obtained. However, this result was scarcely attained. Lord Low decided that it was not competent to fix a price for gas which would admittedly leave a deficit; but this decision was reversed by the Judges of the First Division of the Court of Session, who upheld the rate, though only upon the ground that nothing had been stated to show that the Police Commissioners had not applied their minds to the consideration of raising the greatest amount of income to yield the highest return. Though this decision does not settle the question, it shows that a good deal of latitude will be allowed to corporations who impose a guarantee rate; and that is about sufficient, looking to the circumstance that the power to impose such a rate is scarcely ever required to be put in force.

Extensions of works have not been considerable. Mr. A. Smith, of Aberdeen, has just completed the erection of a large new gasholder. In Glasgow, the extension and renovation of the Dawsholm works of the Corporation has proceeded satisfactorily. There is more work offering for 1895—at Leith, Aberdeen, and probably at Falkirk as well as Forfar.

Oil gas, as represented by the Peebles process, has greatly extended, but in works which are not of the first magnitude. The reason why it has not been introduced into the leading works in the country, is most probably owing to the fact that Mr. W. Young, the inventor, has brought out a modification of the process, which he described before the North British Association of Gas Managers at Glasgow in July last, and the appearance of which has led to renewed negotiations. But for this circumstance, it is likely that it would have, by this time, been introduced into the Edinburgh works, and also, experimentally, into some of the Glasgow stations. Where it has already been installed (in all cases on the original system), it has continued to give satisfaction. With regard to other oil-gas processes, there have been some additions to the places using the Alexander-Paterson system; but I am aware of no other process making progress. Water and oil gas is in a fair way of being adopted permanently in the Paisley Corporation Gas-Works. Incandescent gas lighting has made great advances during the year, both for private and public use.

I think the only death which occurred in the ranks of gas managers was that of Mr. D. B. Esplin, of Forfar. His death led to several changes among managers. In connection with water supply, there falls to be recorded the death of Mr. R. C. Reid, C.E., of the firm of J. and A. Leslie and Reid, of Edinburgh, which led to the appointment of Mr. J. Wilson, C.E., of Greenock, as Engineer to the Edinburgh and District Water Trust.

The Edinburgh Water Trustees have made up their minds to apply to Parliament for authority to take an augmented water supply from the Talla, one of the upper tributaries of the Tweed.

In electric lighting, there is not much to add to what was said last year. The Aberdeen Corporation installation was started in the spring, and the Edinburgh installation, so long talked about, is being constructed. In Glasgow, Dundee, and Aberdeen, it is claimed that the demand for current has been quite satisfactory. A private installation is working at Coatbridge; and others are about to be started at Montrose, Ayr, and probably Stirling. So far, however, there is no immediate prospect of the further extension of the light.

The unexpected has happened in the Falkirk gas arbitration. The Arbitrators—Mr. Corbet Woodall and Mr. E. Herbert Stevenson—have been able to agree. Their award, issued to-day, fixes the price of the undertaking of the Falkirk Joint-Stock Gas Company, to be paid by the Corporation, at £77,050. The Company's claim was for £110,000, and the offer of the Corporation was £50,000. Though it is not likely that the Arbitrators arrived at their result in that way, their decision looks very like a splitting of the difference. They have added £27,050 to the sum offered by the Corporation, and have given £33,000 less than the amount asked by the Company; but then it is to be remembered that the cottages, of which so much was made in the arbitration proceedings, were left out of account—the parties having agreed that the Corporation will take them over at a valuation. This will add another £1000 or so to be paid by the Corporation. All's well that ends well; and I suppose that no one interested will have a grudge that this mountain has turned out to be but a mole-hill after all—except, it may be, some of the legal gentlemen, who seemed to look upon the case as one in which they might find a winter's work. I do not suppose it is anyone's interest now to maintain the litigation over Mr. Barr's appointment as Oversman, because, the work having been done without him, any question as to the validity of his appointment now possesses only an academic interest. I understand, also, that Mr. Barr is to be paid his fee, just as if he had acted, which further looks as if the whole matter is now at an end. As to whether both parties will be satisfied with the award, is another matter. I presume there will not be much complaint on either side. I know that the Gas Company were willing to take between £80,000 and £90,000; and I understand that the Corporation were quite prepared to find that the award would be a sum of at least £70,000. There was therefore not a great deal separating them; and I think it a pity that both sides should have encouraged witnesses to make the extravagant valuations which they did. These varied from £33,000 to £115,000, which was certainly a much wider divergence than was warranted by the facts brought out. The case was rather a complicated one, chiefly on account of the fact that there was an arbitration in 1889, before the amalgamation of the two Companies; and there were the disturbing elements of the duplicate works and mains. These latter were a source of great weakness to the Company's case, because it is undoubted that the plant is not in the best condition. But it was not so much upon the condition of the works that the Corporation based their case as upon the fanciful calculations of experts, who endeavoured to show that the capital standing in the books had not all been subscribed, but had been arrived at by some process of watering; and that the profits of the Company had not been properly earned, the price charged for gas having been too high. On account of these reasons, the Corporation witnesses set themselves to eat away the profit-earning powers of the Company. Not having yet seen the text of the award, I cannot say what deductions the Arbitrators have allowed on the profits before fixing the amount; and therefore I cannot give the number of years' purchase which the price represents. But taking it, first, that they have allowed the whole £4774 which appeared in the last balance-sheet as profit, it works out at 16 years' purchase. It is likely, however, that some deductions from the profits shown were made by the Arbitrators; for Mr. Balfour Browne, for the Corporation, only asked a price fixed on a 16½ years' purchase. On the other hand, when it is remembered that, for the Company, it was asked that the price should be fixed on a 23¼ years' purchase, it is evident that the Arbitrators have not been influenced by the efforts to reduce the profits of the Company last year to £2100 or thereby, because even at as much as 23¼ years' purchase, that would have brought out a price of only about £60,000. Looked at all round, I should say that the decision ought not to be unpopular with the shareholders of the Company. They receive the full total of their capital as it appears in the books, and some 50 per cent. besides. That is, they will have a little over £150 to invest where they had £100 before; and in order to realize the £5 11s. 8d., which is the average return they have had since the formation of the Joint-Stock Company, they will require to find an investment which yields about 3¼ per cent. That, even in these days, should not be very difficult. This way of treating the subject, makes the price look quite a fair one. Some of the ratepayers may grumble at it; but I think that every reasonable person will admit that, had the price been less, it would have been unfair to the shareholders, who have been forcibly dispossessed of a holding which bade fair to continue to yield them the return they had been having. Even looked at from the Corporation standpoint, what they will require to pay, if they borrow the money at 3¼ per cent.—which they should be able to do—would be, upon the £27,000, about £3273 a year. The Company divided in dividend, on an average, £2964 per annum, which leaves only £309 to be made up; and as rents of cottages and Directors' fees amounted to more than £220 of this sum, the balance should, in a growing concern, be easily met. Of course, there will be, in addition, a capital expenditure of several thousands of pounds upon the works; but the annual outlay upon that should be easily met out of revenue.

A curious litigation has been begun by some owners of property in the Maryhill district of Glasgow, against the Glasgow Corporation, with regard to the right of the Corporation to lay a gas-main in a private thoroughfare. The complainers seek interdict of the Corporation laying pipes through their property for the supply of districts beyond. As the answers of the Corporation have not yet been lodged, it is impossible to say how the question may work out; but it looks as if the Magistrates of the city were within their rights in laying a gas-main in any thoroughfare where they may consider it necessary. Of course, they may have to pay compensation.

In the end of last week, as all your readers know, the United Kingdom was visited by a very violent gale of wind. I have been endeavouring to ascertain whether damage has been inflicted upon gas-works; and I find that, fortunately, it has been very little. The

greatest amount was at Aberdeen, where a portion of the chimney of the retort-house was blown down. The chimney was about 80 feet high; and some 60 feet of it came down. It fell into an adjoining chemical works, putting a man and a boy in peril, and injuring the latter, though not seriously. At Dumfries, the lightning conductor upon the chimney of the gas-works was blown away.

There was a proposal this week before the Gas Committee of the Aberdeen Corporation, for the construction of new mains to supply the rapidly growing out-districts which surround the city. The estimated cost is £5200. The expenditure was contemplated, and is provided for by the Gas and Water Act which the Corporation obtained last year. The same may be said of a further suggestion to extend the condensers in the works. The condensers are horizontal; and as they are found not to be equal to dealing with the increased quantity of gas passing at a high heat through them, it is proposed to raise the upper line of piping, and to introduce a new length in the middle. The estimated cost is £2300.

Referring to the paragraph in our correspondent's "Notes" last week on the subject of the management of the Dunbar Gas-Works, a resident in the town writes as follows: "The action of the Dunbar Gas Commissioners, and the treatment of their late Manager, Mr. J. M'Kechnie, formed the principal topic of conversation in the burgh last week; and the sympathies of all right-thinking people have been with the Manager. Mr. M'Kechnie was sent to Dunbar by Mr. W. Foulis, of Glasgow, and recommended by him as a thoroughly practical gas manager. During the 2½ years he held his office, he made many improvements at the works, and introduced several modern appliances—among them a new system of regenerative retorts. He also fitted up a new engine and exhauster, and, by good management, carried on the works with half the men that had formerly been required. During all this time, Mr. M'Kechine was continually worried and bothered by the interference of the Commissioners with the internal management of the works. Under his management, the price of gas had been reduced; and, at a meeting held lately, the Commissioners, on a vote, awarded Mr. M'Kechnie a bonus of £10 for his services in fitting up the machinery, &c. Under a new convenership, friction again ensued between the Manager and the Commissioners, culminating in Mr M'Kechnie tendering his resignation. The reason of this step being taken was as follows: Two of the men, employed at 24s. a week of six days, petitioned for a rise of wages, as men employed in a similar capacity in neighbouring works were paid at a higher rate. This, the Commissioners refused to grant. On the men again requesting their application to be entertained, the Convener sent out two men to relieve the malcontents—one a mason's labourer, and the other a carter. Not being up to the work, mistakes were the result; causing Mr. M'Kechnie to sit up for three nights in the works, in case the gas supply should fail. He thereupon (acting on his own responsibility) sent for the former men, so that the work might be gone through in a businesslike way. This action was resented by the Commissioners, who remonstrated with him. The Manager, however, maintained that he, and he alone, knew what men were required, and how to employ them; and, seeing that he was so hampered and interfered with in his management, he tendered his resignation, which was accepted by the Convener and a majority of the Commissioners. A young man from Edinburgh has been appointed interim Manager; and he has frankly confessed that he cannot work the place with the number of men employed by Mr. M'Kechnie, and must have extra hands. Surely now the Commissioners will find out their mistake in losing Mr. M'Kechnie. It has, however, been the same all through. The former Manager (Mr. Cuthbert), who had control of the works for six years, was, after the acquisition of the undertaking by the Corporation, so badgered and tormented that his health could not stand the strain, and he resigned; and now his successor, who has done everything that knowledge and hard practical work could do for the place, has been compelled to do the same. Surely, a state of matters like this has no parallel in Scotland."

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Dec.* 29.

Sulphate of Ammonia.—The market has still a quiet appearance, to which the present broken week has added some irregularity. Now that prices are apparently on such a reasonable basis, consumers may shortly be influenced to send their orders; and this would have an immediate effect of steadying the position. Of course, there is still the fact that dealers are quoting for delivery into Spring at the parity of about to-day's values; but these tactics would soon disappear were there signs of movement on the part of consumers. Quotations remain at about £10 17s. 6d.

LONDON, *Dec.* 29.

Tar Products.—Benzols are firm, with a tendency to improve in value. The production of benzol during the year has been very much less than was estimated. There are no stocks in makers' hands; and report says that buyers have been greatly misinformed on this point. The consumption of benzol for enriching gas has evidently removed not only the surplus production, if any there be, but has taken up a considerable quantity that formerly went into colour. Pitch is flat, with a tendency to weaker values. Creosote and common oils are also in over-production. There is a better inquiry for solvent naphtha; but the price is weak. Carbolic acid is now being controlled by a Committee; and the tendency will be to higher prices. Anthracene is firm; while tar is somewhat weaker. The week's quotations are as follows: Tar, 18s. to 22s. per ton. Pitch, prompt, 36s.; forward, 32s. Benzols, 90's, and 50's, 1s. 1d. Solvent naphtha, 1s. 2½d. Toluol, 1s. 3d. Crude naphtha, 5d. Creosote, liquid, 2d.; ordinary, 1½d.; salts, 20s. Cresylic acid, white, 1s.; brown, 9d. Carbolic acid, 60's, nominal, 1s. 8d. Anthracene, "A," 1s. 1½d.; "B," 10½d.

Sulphate of Ammonia continues in a languid state; but it is felt that the turn of the year will force operators to cover. Transactions during the week have fluctuated between £10 17s. 6d. and £11 2s. 6d. in all positions, less 3½ per cent.; while 10 oz. gas liquor is offered at 6s. 6d. to 8s. 6d.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—The coal trade of Lancashire during the year just closed has passed through a period of exceptional depression. Notwithstanding the fact that collieries commenced the year completely bare of stocks, owing to the previous four months' stoppage of the pits, supplies, except during the first few weeks, have been far in excess of requirements; and the pits, for the greater part of the year, have not been running much more than half-time. The exceptional mildness of last winter, of course, threw a large quantity of round coal on the market; and long before the summer season commenced, collieries had accumulated heavy stocks on the pit-banks. With the exception of a temporary check to the downward tendency of the market during the Scotch miners' strike, when large quantities of round coal were sent from Lancashire into Scotland, prices steadily receded all through the year, until they have touched prices as low as, if not lower than, those ruling prior to the strike, and which coalowners regarded as a justification for demanding a reduction of 40 per cent. in wages. Round coals, which in January were fixed at about 15s. per ton for best Wigan Arley, 13s. for Pemberton four-feet and seconds Arley, 12s. for commoner qualities of house-coal, and 10s. to 10s. 6d. for steam coal, have steadily receded; and at the close of the year best Wigan Arley did not average more than about 10s. 6d. per ton, Pemberton four feet and seconds Arley 9s. to 9s. 6d., common house-coal 7s. to 7s. 6d., and steam and forge coals 6s. 6d., with as low as 5s. 6d. and 6s. taken for shipment. These prices are fully 1s. under those quoted during July; whilst the leading Manchester firms have been compelled to reduce in December the "lowest summer rates" which they were quoting in October and November. Engine fuel has fluctuated, as supplies of slack have been regulated by the demand for round coal. During the earlier part of the year, when the output of slack was restricted, prices gradually hardened up to about 6s. 6d. and 7s. per ton at the pit mouth for best, and 5s. to 5s. 6d. for common slack. But with the increased production of slack, when large quantities of round coal were being sent away to Scotland, supplies became excessive, with prices gradually getting down to 3s. and 3s. 6d. per ton for common, and 4s. 6d. to 5s. for the better sorts. More than ordinary importance has necessarily been attached to the gas coal and locomotive fuel contracts during the year, as it was alleged by the officials of the Miners' Federation that the excessive cutting for these contracts in previous years had mainly brought about the demand for a reduction in wages. Soon after the collieries resumed work, a combination of Lancashire coalowners was formed, under the name of the Coal Sales Association, with the object of regulating prices generally, but chiefly to endeavour to prevent needless competition for the gas coal and locomotive fuel contracts during the ensuing season. This combination proved, however, altogether powerless to stay the steady downward tendency of the market as regards the general trade of the district; and towards the close of the year it collapsed altogether, owing to the secession of many of the leading Lancashire collieries. It had, however, the effect, for the time being, of strengthening the position of the coalowners with regard to the gas coal and locomotive fuel contracts, by bringing about more united action than had previously been possible as to the basis upon which tenders should be sent in. Early in the year, negotiations were opened up with the Yorkshire coalowners, who had previously been the keenest competitors for the gas coal contracts; and some sort of arrangement was made not to tender under the 1892 prices—which would have meant an advance of about 1s. per ton on the basis of 1893 contracts. A Joint Committee was formed representing the gas coal collieries in Lancashire and Yorkshire; and meetings were held from time to time, with a view of arranging as to the basis upon which tenders should be sent in for the important contracts coming upon the market. Shortly after the gas coal season had opened, it was reported to the Committee that one or two contracts had been placed at advances of 6d. to 1s. per ton upon the 1893 rates; and a strong feeling was expressed by the representatives of the various gas coal collieries that they should hold out for a substantial advance over the 1893 basis. Any really fixed united action was, however, soon found to be impracticable. When the important Manchester gas coal contracts came upon the market, there was an understood arrangement that tenders should not be sent in except at prices 6d. above those of the previous year; but the contracts were ultimately settled practically on much the same basis as the 1893 rates. As the season advanced, other large contracts had to be taken at practically very little over the previous prices; and the advances which were obtained scarcely averaged more than 3d. per ton, although 6d. to 9d. per ton was secured for some of the smaller contracts placed early in the season. The average basis upon which gas coal contracts were placed, gradually settled down to about 7s. per ton at the pit for common, and 8s. to 8s. 6d. for the better qualities of screened gas coal. As, however, illustrating the continued weakening in prices, a gas coal contract for Belfast, placed late on in the year, was accepted at rates considerably under the above. Usually a considerable portion of this contract has been secured in Lancashire, and several of the local collieries quoted on the basis of about 13s. per ton delivered at Belfast. But the bulk of the contract went to Yorkshire, at a price which would probably scarcely leave 6s. 6d. per ton at the pit mouth. For the locomotive fuel contracts, however, coal owners managed to do rather better with regard to advances upon the previous year's rates. The average basis upon which these contracts were placed was about 6s. 9d. to 7s. per ton at the pit mouth—representing an advance of about 6d. to 9d. over the rates obtained for 1893 contracts.

Northern Coal Trade.—Though the holidays have caused some interruption in the consumption of coals, yet the lessened output has allowed stocks to be decreased even; and that is a remark that especially applies to the gas coal trade, for the consumption of gas has been about at its largest. Best Northumbrian steam coal is steady at 9s. 3d. per ton f.o.b.; whilst second qualities may be had at 8s. 6d., and steam smalls at 3s. 6d.—the demand for the latter kind being fairly good. Manufacturing coals are in only moderate request; but the tendency of the prices is lower than those that have ruled for some time. Though the demand for gas coals has been so large, it has been

barely enough to keep the pits fully at work; so that the stoppage for the holidays will allow some orders to accumulate. Prices of best Durham gas coals vary from 7s. 3d. to 8s. per ton f.o.b.; and most of the deliveries on contract are roughly at about that basis. Best blast furnace coke is fairly steady for local consumption; but the exports are still very small. The f.o.b. price is from 13s. to 14s. per ton. Gas coke is abundant, and its price unchanged; but sales on contract rather lag behind this winter.

Scotch Coal Trade.—Business continues dull, but steady; the demand being, if anything, a little better than last week. The miners are only taking one week's holiday, which will make stocks keep up. The quotations are: Main, 6s. 9d. per ton f.o.b. Glasgow; ell, 7s. 6d. to 7s. 9d.; splint, 7s. 6d. to 7s. 9d.; and steam, 8s. 3d. to 8s. 6d. At the close of last year, they were: Main, 9s. 6d. to 10s. per ton; ell, 11s. to 11s. 3d.; splint, 9s. 6d. to 10s.; and steam, 11s. 6d. to 12s. Shipments for the week amounted to 136,087 tons—an increase over the quantity in the previous week of 5241 tons, but a decrease as compared with the corresponding week of last year of 39,890 tons. For the year to date, the total shipments have been 5,212,648 tons—a decrease as compared with the quantity in the corresponding period of 1893 of 2,523,152 tons.

Gas v. Oil for Tramcar Lighting.—At a recent meeting of the Huddersfield Town Council, it transpired that the Tramways Committee had received a report from the Manager (Mr. Pogson), showing that the lighting of the tramcars with oxy-oil gas would cost about £20 a year more than with oil lighting. The Committee authorized the adoption of gas lighting.

Augmentation of the Water Supply of Malton.—Mr. R. Richardson, the Surveyor to the Malton Local Board, reported to that body last Thursday in favour of the construction of an additional reservoir and well near the present reservoir. He also stated that the means recently taken to keep the water pure, by preventing contamination with flood water from the River Derwent, were calculated to be available for a flood up to 12 feet above the summer level. The matter was referred to the new Urban District Council.

The Finances of the Mansfield Corporation Gas Department.—A Sub-Committee of the Finance Committee of the Mansfield Corporation, recommended the Town Council, in November last, to offer to pay off the present holders of gas debentures at the rate of £114 per cent. in cash; and to give them the option of taking new 3 per cent. stock at par, in exchange, at the following rates: Holders of the £50,000 stock created in 1878-80-81, at the rate of £117 for each £100; holders of £5000 stock created in 1882, at the rate of £117 10s. for each £100; and holders of £5000 stock created in 1890, at the rate of £118 for each £100. The matter was adjourned in order to give the Gas Committee an opportunity of considering it. This they have since done, with the result that, on their recommendation, the Council have adopted the proposals of the Finance Sub-Committee.

Winding Up of the St. Ives (Cornwall) Gas Company.—According to the observations of the Official Receiver (Mr. C. J. Stewart), issued under a winding-up order made in this case on Oct. 31 last, the Company was registered on March 8, 1893, and was formed, in the words of the prospectus, "to acquire the old-established gas-works and continue the supply of gas at St. Ives." The business of the Company has since been conducted there and at the registered office, No. 70, Fenchurch Street, E.C. The nominal capital was £6000, divided into 1200 shares of £5 each. On May 4, 1893, the date of the first allotment, there were subscribed for and issued 228 shares; and it appears that there have been further issues of shares, amounting in all to 179, at irregular intervals since. These, with 20 shares issued to the Directors and seven to the signatories to the Memorandum and Articles of Association, which are not referred to in the minute-book, comprise the total issue, amounting to 434. The Official Receiver, after giving other details, states that possession of the works was obtained on April 1, 1893, when operations were commenced. The insolvency of the Company is attributed mainly to the insufficiency of capital. The accounts show liabilities to the extent of £3932, of which £717 are unsecured, with an estimated surplus in assets of £206. As regards contributories, the deficiency is returned at £1932.

The Quality of the Gas Supply at Chester.—The Mayor of Chester (Mr. W. H. Churton) has been taken to task for the statements respecting the quality of the gas supplied by the local Company which he made at the inquiry held recently as to the proposal of the Corporation to borrow £25,000 for electric lighting purposes. He asserted that the gas had been "bad for some time;" and, worse than that, "it had been something shocking during the last month." The Chairman of the Gas Company (Mr. J. Gamon) waited until he could obtain the report of the official tests made at the Town Hall during the month referred to; and then he wrote to his Worship pointing out that it certified that the illuminating power of the gas was equal to 17·01 candles, while the quality the Company are required to supply is 15 candles. In addition to this, the tests made at the works show the gas has been maintained for years past at 17 candles, and as free as possible from impurity of every kind. In his letter, Mr. Gamon, referring to the public lighting, also reserved to the Company the power to review the terms of the present arrangement with the Town Council (which are exceptionally liberal), in the case of electric lighting being adopted in any of the streets. The Mayor, in his reply, declined to withdraw his complaint as to the quality of the gas. He said he did not suggest that the gas supplied was below the prescribed standard—that was another question altogether. Unfortunately for the consumers the standard was much too low—"it is only the minimum standard fixed 36 years ago; and there has been nothing all these years, except perhaps the want of a little wholesome competition, to prevent the Company, with its very ample revenue, working to a higher and more up-to-date standard." Upon this latter remark, Mr. Gamon has pointed out that the general supply of gas in the majority of towns in the kingdom, and noticeably in London, is of a lower standard of illuminating power than that supplied in Chester.

New Laboratory at the Burnley Gas-Works.—The Gas Committee of the Burnley Corporation have accepted tenders for the erection of a new laboratory at the gas-works; the cost being about £500. This has followed upon the erection of the new office and the extensions effected during the past year.

The New Water-Works for St. Austell.—Regarding the offers which were recently submitted for the construction of a new reservoir and filter-beds for the St. Austell Local Board (a reference to which appeared in the JOURNAL a fortnight ago), we learn that the lowest tenderer, Mr. T. J. Smith, who inadvertently omitted the cost of constructing the filter-beds, has since withdrawn his tender; and in consequence the Board issued invitations for fresh offers. Four contractors responded; and Mr. A. Delbridge, of Camborne, has been selected to carry out the work—the amount of his tender being £2450.

Extensive Improvements at the Bolton Gas-Works.—The Corporation of Bolton have decided to carry out a number of improvements at their Gas Street works; the aggregate cost being estimated at about £20,000. The alterations include the resetting of the retort-benches on the regenerative system, and the improvement of the exhausters and governors. The effect of these alterations will be the production of gas at these works at considerably less cost, and the labours of the employees carried on under more comfortable conditions. Some time since, the Corporation adopted the regenerative system at Lum Street; and the success which has followed has led to the alterations now proposed at the other station.

Staines and Egham Gas Company.—The annual meeting of this Company was held on the 20th ult. Mr. W. Weller, who presided, said that the Directors were pleased to be able to congratulate the shareholders on another satisfactory year's trading, and also on the thoroughly good working condition of the plant. It would be seen by the balance-sheet that, although the reduction of 2d. per 1000 cubic feet meant more than £600 less income, it had resulted in an increase of about £60 in the revenue; and the Directors hoped that the further reduction of 2d. to be made from Jan. 1 would have the same result. A resolution was passed adopting the report and accounts, and confirming the Directors' recommendation that the usual dividend of 12½ per cent. be paid on the original, and 9½ on the new 7 per cent. shares.

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

(For Stock Market Intelligence, see ante, p. 18.)

Issue.	Share	When ex-Dividend.	Dividend on Div. & Bonus.	NAME.	Paid per Share	Closing Prices.	Rise or Fall in Wk.	Yield upon investment.
£			p. c.	GAS COMPANIES.				£ s. d.
590,000	10	11 Oct.	10½	Alliance & Dublin 10 p. c.	10	19½—20½	..	5 2 5
100,000	10	,,	7½	Do. 7 p.c.	10	13½—14½	..	5 3 5
300,000	100	2 July	5	Australian (Sydney) 5 % Deb.	100	105—107	..	4 13 4
220,000	5	14 Nov.	6½	Bombay, Limited	5	6½—6¾	..	4 16 5
42,000	5	,,	6½	Do. New	4	4½—5	..	5 4 0
380,000	Stck.	15 Aug.	11½	Brentford Consolidated	100	233—238	..	4 16 8
180,000	,,	,,	8½	Do. New	100	183—188	..	4 10 5
220,000	Stck.	28 Sept.	11	Brighton & Hove Original	100	217—222	..	4 19 1
888,500	Stck.	30 Aug.	5	Bristol	100	115—120	..	4 3 4
320,000	20	28 Sept.	11½	British	20	48 -49	..	4 11 5
50,000	10	30 Aug.	11½	Bromley, Ordinary 10 p. c.	10	21½ - 22½	..	5 2 2
51,510	10	,,	8½	Do. 7 p. c.	10	16½—17½	..	4 17 2
328,750	10	14 Nov.	2	Buenos Ayres (New) Limited	10	6 -7	..	2 17 1
200,000	100	2 July	6	Do. 6 p. c. Deb.	100	101—103	..	5 15 5
150,000	20	12 July	8	Cagliari, Limited	20	27—28	..	5 14 3
550,000	Stck.	11 Oct.	13	Commercial, Old Stock	100	272—277	..	4 13 10
165,000	,,	,,	10	Do. New do.	100	200—205	..	4 17 7
160,762	,,	13 Dec.	4½	Do. 4½ p c. Deb. do.	100	130—133	..	3 6 8
800,000	Stck	13 Dec.	13	Continental Union Limited	100	239—243	..	5 7 0
200,000	,,	,,	10	Do. 7 p. c. Pref	100	205—210	..	4 15 3
535,000	Stck	30 Aug.	5	Crystal Palace Ord. 5 p.c. Stk	100	117—122	..	4 1 11
486,090	10	27 July	11	European, Limited	10	22½—23½	..	4 13 7
354,060	10	,,	11	Do. Partly paid	7½	16—17	..	4 17 1
5,646,590	Stck	15 Aug.	12	Gaslight & Coke, A, Ordinary	100	251—256	..	4 13 8
100,000	,,	,,	4	Do. B, 4 p. c. max.	100	105—110	..	3 12 9
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	100	277—282	..	3 10 10
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	100	130—135	..	3 14 1
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	100	200—205	..	3 13 2
1,300,000	,,	,,	7	Do. H, 7 p. c. max	100	182—187	..	3 14 11
163,000	,,	,,	10	Do. J, 10 p. c. Prf.	100	275—280	..	3 11 5
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	100	165—170	..	3 10 7
1,061,150	,,	13 Dec.	4	Do. 4 p. c. Deb. Stk.	100	127—130	..	3 1 6
294,850	,,	,,	4½	Do. 4½ p. c. do.	100	135—140	..	3 4 3
908,000	,,	,,	6	Do. 6 p. c. do	100	188—192	..	3 2 6
3,800,000	Stck.	14 Nov.	12	Imperial Continental	100	225—230	..	5 4 4
75,000	5	13 Dec.	6	Malta & Mediterranean, Ltd.	5	5—5½	..	5 9 1
560,000	100	1 Oct.	5	Met. of Melbourne, 5p. c. Deb.	100	110—112	..	4 9 3
541,920	20	14 Nov.	5	Monte Video, Limited	20	15—16	..	6 5 0
150,000	5	29 Nov.	8	Oriental, Limited	5	7—7½	..	5 6 8
60,000	5	13 Sept.	7	Ottoman, Limited	5	4½—4¾	..	7 7 4
166,870	10	31 Jan.	2	Pará Limited	10	1½—2½	..	8 0 0
420,000	100	2 Nov.	6	People's Gas of Chicago— 1st Mtg. Bds.	100	100—105	..	5 14 3
500,000	100	1 Dec.	6	and Do.	100	95—100	..	6 0 0
150,000	10	11 Oct.	6	San Paulo, Limited	10	8½—9½	..	6 6 4
500,000	Stck.	30 Aug.	15½	South Metropolitan, A Stock	100	337—342	..	4 10 8
1,350,000	,,	,,	12	Do. B do.	100	287—291	+1½	4 2 4
260,000	,,	,,	13	Do. C do.	100	293—298	+1	4 7 2
750,000	,,	12 July	5	Do. 5 p. c. Deb. Stk.	100	169—174	+2	2 17 6
60,000	Stck.	30 Aug.	11½	Tottenham & Edm'nton, "A"	100	220—225	..	5 2 2
				WATER COMPANIES.				
746,021	Stck.	28 Dec.	15½	Chelsea, Ordinary	100	287-292*	..	3 9 4
1,719,514	Stck.	11 Oct.	8	East London, Ordinary	100	232—237	..	3 7 7
634,740	,,	28 Dec.	4½	Do. 4½ p. c. Deb. Stk.	100	130-135*	+¾	2 18 0
700,000	50	13 Dec.	8½	Grand Junction	50	120—123	..	3 9 1
708,000	Stck.	15 Aug.	12	Kent	100	305—310	..	3 17 5
1,043,800	100	28 Dec.	9½	Lambeth, 10 p. c. max.	100	267-272*	+¾	3 9 10
406,200	100	,,	7½	Do. 7½ p. c. max.	100	205-210*	..	3 11 5
330,000	Stck.	28 Sept.	4	Do. 4 p. c. Deb. Stk.	100	135—138	..	2 17 11
500,000	100	15 Aug.	12½	New River, New Shares	100	385—390	..	3 2 2
1,000,000	Stck.	27 July	4	Do. 4 p. c. Deb. Stk	100	140—145	..	2 15 2
902,300	Stck.	13 Dec.	6	S'thwk & V'xhall, 10p. c. max.	100	167—172	..	3 9 10
126,500	100	,,	6	Do. D 7½ p. c. do.	100	160—165	..	3 12 9
1,155,066	Stck.	13 Dec.	10	West Middlesex	100	275—280	..	3 11 5

*Ex div.

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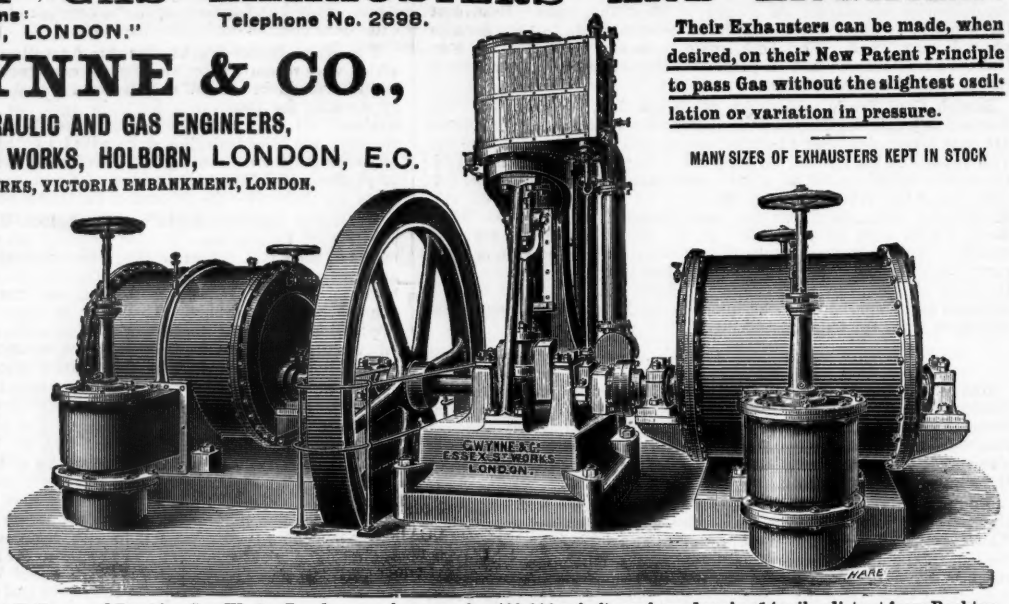

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Orders for Alterations in, or Stoppages of PERMANENT ADVERTISEMENTS should be received not later than the FIRST POST on SATURDAY.

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Sealed tenders, endorsed "Fire-Clay Goods," to be sent to me not later than Tuesday, the 15th day of January, 1895.
By order,
A. B. PILLING,
Town Clerk.
Municipal Buildings,
Heywood, Dec. 20, 1894.

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NOTICE is Hereby Given, that the TRANSFER BOOKS of this Company, so far as they relate to CAPITAL STOCKS, WILL BE CLOSED at Four o'clock p.m., on Tuesday, the 8th day of January next, and will be RE-OPENED immediately after the Half-Yearly General Meeting of the Company, to be held in the month of February next.
By order,
JOHN WILLIAM FIELD,
Secretary and General Manager.
Chief Office: Horseferry Road,
Westminster, S.W., Dec. 29, 1894.

NOTICE.

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COMPILED BY

F. SOUTHWELL CRIPPS,

Associate Member of the Institution of Civil Engineers; Fellow of the Imperial Institute; Member of the Institution of Gas Engineers; Member of the Society of Arts
AUTHOR OF
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Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
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Ash. . . . . 1·34 Per Cent.
Tar . . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor $94\frac{1}{2}$ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COALFIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

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HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

LABORLESS WORK In 1895.

ENGINEERS AND MANAGERS

Making preparations to adopt

SELF-ACTING SYSTEMS OF CARBONIZING In 1895,

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We send skilled Draughtsmen to get Particulars for Detail Plans.

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For Carbon Bisulphide, Sulphuretted Hydrogen, and Carbonic Acid in Coal Gas.
The Materials for the above Tests may be obtained from
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HEATHCOTE GAS COAL.
Rich in Illuminating Power & Yield of Gas.
Above the average in Weight & Quality of Coke.
Maintains a High Standard in Residuals.
THE GRASSMOOR Co., LD.,
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CANDLE SAFETY LAMPS.

No. 1. No. 2. No. 3.
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COKE BREAKERS.
G. R. Mather & Son, Engineers, Wellingborough

BOLDON GAS COALS.
Worked by THE HARTON COAL CO., LTD.
Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Bombay Gas Company, San Paulo Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For prices, &c., apply to the
HARTON COAL COMPANY, LIM
Newcastle-on-Tyne.
W. H. PARKINSON
FITTER

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For prices, f.o.b. Ship or Delivered by Rail, apply to

THE WALLSEND & HEBBURN COAL COMPANY, LTD.
8 Lombard Street,
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W. RICHARDSON, Fitter.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD
BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, NEAR DEWSBURY.

THE
STOVE FOR 1894-5.

THE KING OF STOVES

A SANITARY GAS-STOVE

Requires no Flue.

Guaranteed free from Smell and Fumes.

ADVANTAGES:—

1. Freedom from smell or fumes.
2. Great heating capacity.
3. Absolute safety. Can be placed on a carpet or near a wall. Recommended by Fire Insurance Companies.
4. Requires no flue; hence can be placed in any part of a room.
5. Heat under perfect control.
6. Absolute cleanliness.
7. Cheerful in appearance.

SUITABLE FOR

SHOPS, HALLS, OFFICES, CLUBS, SITTING-ROOMS, BEDROOMS, LIBRARIES, BATH-ROOMS, AND ALL DOMESTIC PURPOSES, ALSO FOR CHURCHES, CHAPELS, MISSION-ROOMS, ETC.

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JOHN CLARKSON MAJOR,

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OXIDE OF IRON.

JAMES HUNTER, MINER, AND SHIPPER OF NATURAL IRISH BOG ORE.

This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.

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Telegrams: "HUNTER, PORT GLASGOW."
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PRICES REDUCED.
(THOMAS & SOMERVILLE'S PATENT.)

New Design, with two Cutting Rollers, making less Breeze than their old pattern.

GEORGE WALLER & CO.,
PARK STREET, SOUTHWARK, E.C.,
And at STROUD, GLOUCESTERSHIRE.

KENT'S THICK GAS COAL

RAISED AT

The Wharncliffe Woodmoor Colliery,
BARNSLEY.

Yield of Gas, nearly 12,000 *Cubic Feet per ton of Coal; and Illuminating Power, nearly* 17½ *Candles.*

The following is a complete ANALYSIS made by Mr. R. O. PATERSON, C.E., Gas-Works, Cheltenham:—

Specific Gravity (Water 1). .	1·276
Weight of One Cubic Foot. .	79·700 lbs.

PROXIMATE ANALYSIS.

Moisture in Coal	2·68 per cent.
Volatile Matter	35·60 ,,
Fixed Carbon	58 80 ,,
Sulphur	0·96 ,,
Ash	1·96 ,,

COMMERCIAL ANALYSIS.

Gas per Ton of Coal. . . .	11,760 cub. feet.
Gas per Cubic Foot of Coal .	418 ,,
Illuminating Power	17·44 candles.
Value of One Cubic Foot in Sperm.	418 grains.
Value per Ton of Coal in Sperm.	703 lbs.
Coke per Ton of Coal . . .	1367 ,,
Coke	61·05 per cent.
Ash in Coke.	3·21 ,,
Sulphur Eliminated with Volatile Products per Ton of Coal	9·4 lbs.
Sulphur in Coke per Ton of Coal	12 ,,
Ammoniacal Liquor per Ton of Coal	19·7 galls.
Tar per Ton of Coal	12·2 ,,

R. O. PATERSON, C.E.

Gas-Works, Cheltenham, 8th August, 1894.

For Price, &c., apply to
THE
Wharncliffe Woodmoor Colliery Co
LIMITED,
BARNSLEY.

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Brettell's Estate

FIRE-CLAY & BRICK WORKS,
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Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.

LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,
COUNTY OF DURHAM.

Available output up to 5000 tons per day,
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO

S. J. DITCHFIELD,
SEAHAM HARBOUR, COUNTY OF DURHAM.

THORNLEY GAS COALS

WORKED BY THE

WEARDALE IRON AND COAL COMPANY, Ld.

OUT OF THEIR

THORNLEY AND WHEATLEY HILL COLLIERIES.

The Analysis made by Messrs. J. and H. T. Pattinson, Public Analysts for Northumberland, gives 10,500 cubic feet of Gas per ton, with an Illuminating Power of 16·3 Candles and 67·3 per cent. of Coke. The following is a Working Analysis made of these Coals by the Tudhoe and Sunderland Bridge Gas Company:—

[COPY.]

TUDHOE AND SUNDERLAND BRIDGE GAS COMPANY.
Tudhoe Gas-Works, Spennymoor, 8th June, 1893.

Messrs. The

WEARDALE IRON & COAL COMPANY, LTD.

GENTLEMEN,

For the last two months we have used your **THORNLEY GAS COAL** exclusively at these gas-works; and I have pleasure in herewith giving you the actual results obtained during the trial.

Yield of Gas per ton: 10,300 cubic feet.
Yield of Coke: 13½ cwt.
Illuminating Power of Gas, average of a series of tests, **17 Sperm Candles.**
The Coke was of excellent quality.
The following is a complete ultimate Analysis of the Coal.

	Per Cent.
Carbon	83·128
Hydrogen	5·116
Oxygen	7·401
Nitrogen	0·585
Sulphur	0·620
Ash	3·130
Water	0·020
	100·000

Analysis of the Coke.

Carbon	93·31
Sulphur	0·61
Ash	5·00
Moisture	1·08
	100·00

I am, Gentlemen,
Yours truly,
A. B. COWAN,
Manager.

For Price, &c., apply to the

WEARDALE IRON & COAL Co., Ld.
QUAYSIDE, NEWCASTLE-ON-TYNE.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
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Prices and Analysis of all the Scotch Cannels on Application.

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Societe de Produits Refractaires
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EXPORTATION *via* ANTWERP.
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Special attention to Repairs.
Seven Saturators placed with us the present Year.
HIGHEST REFERENCES ON APPLICATION.

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Highest Results in Gas, & Excellent Coke.
QUOTATIONS ON APPLICATION TO
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LIMITED,
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MANUFACTURERS OF
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FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
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AND ENGINEERS' TOOLS GENERALLY.
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REAL SILKSTONE GAS COAL
ANALYSIS AND PRICES ON APPLICATION.
T. B. KITTEL, SHEFFIELD.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for
CANNEL & COAL.

TYNE
BOGHEAD
CANNEL.
Yield of Gas per ton . . . . . 13,155 cub. ft.
Illuminating Power . . . . . 36·22 candles.
Coke per ton . . . . . 1,301·68 lbs.

EAST PONTOP
GAS COAL.
Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 70 per cent.

SOUTH PELAW MAIN
GAS COAL.
Yield of Gas per ton . . . . . 10,500 cub. ft
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 73·1 per cent.
For Prices and complete Analysis, apply to
THOS. W. DANCE & SONS,
COAL OWNERS, NEWCASTLE-ON-TYNE;
OR
E. FOSTER & CO.,
21, JOHN STREET, ADELPHI LONDON, W.C.

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[MATTHEW MILDRED]
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Automatic Penny-in-the-Slot Meter

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An application of the "Vernier Principle," ensuring Mathematical Accuracy of Registration, combining all the latest Scientific Improvements.

PRICE INSTANTLY, SIMPLY, & READILY ADJUSTED *IN SITU*, BY SINGLE FEET OR HALF FEET, WITHOUT CHANGE OF WHEELS.

STRENGTH, DURABILITY, & MINIMUM SIZE.

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BASE OR MISTAKEN COIN DETECTED & RETURNED.

Terms on Application.

New Catalogue of GAS-FITTINGS of novel and registered designs, with Special Quotations to Gas Companies, now in the Press for circulation early in the New Year.

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Contracting Engineers for

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MAKERS OF

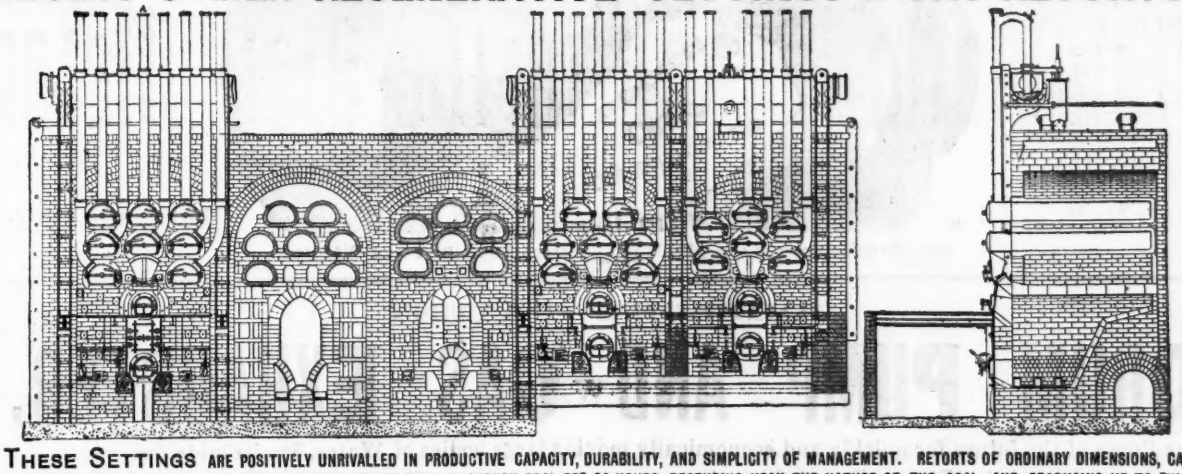
LARGEST GASHOLDER IN THE WORLD

ALSO THE LARGEST METAL TANK

See Advertisement last week, also next week

MAKERS OF RETORT-LIDS OF ALL FORMS & SHAPES BY SPECIAL HYDRAULIC MACHINERY

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY, AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS, CARBONIZING FROM 18 TO 24 CWT. OF ENGLISH AND 21 TO 26 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Specifications are furnished for the complete erection of Ovens, with or without Retort and Bench Mountings; or complete erection undertaken if required, and carried out by specially Trained Workmen.

Further particulars may be obtained on application to the Patentee's Agents: C. M. HAMILTON, 5, Stuart Street, Shawlands, Glasgow; J. E. FISHER, Stourbridge; JOHN WALSH & SONS, Retort Builders, Halifax, Yorkshire; RICHARD TURNER, Retort Builder, Denton, Lancashire; and from the Principal Agent, R. F. HISLOP (son of Patentee), Gas-Works, Paisley, N.B.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non*

TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

SPENT LIMES NO LONGER WASTE PRODUCTS

Under G. R. HISLOP'S Patents, all Spent Limes are most effectually, economically, and continuously recovered at from one-third to one-half the cost of New Lime. The results are a surprise to all who have inspected the process, and are entirely satisfactory to all now using it.

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PLANS, SPECIFICATIONS, AND ESTIMATES SUBMITTED.

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FOR GASHOLDERS, BOILERS, GIRDERS, TANKS, COVERS, &c., &c.; ALSO SET SCREWS, WASHERS, SPIKES, AND FISH-PLATE BOLTS.

Sole Manufacturers of the "PERFECT" Patent LOCK-NUT and WASHER.

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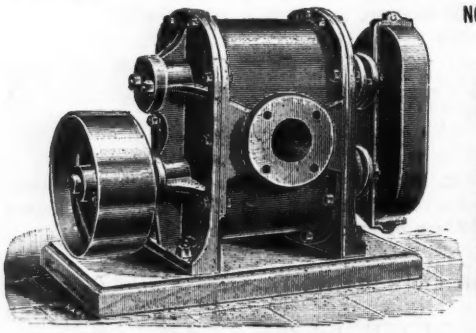
DRUM PUMP AND GAS EXHAUSTER.

The Pump of the future for quickly and economically moving large bodies of Water, Semi-Fluids, &c.

The force of the Piston Pump with the capacity of the Centrifugal combined.

NO SLIDES OR FRICTIONAL WORKING PARTS.



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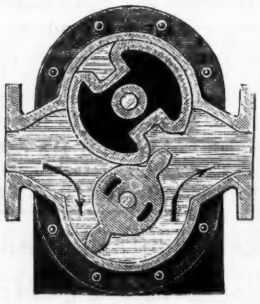

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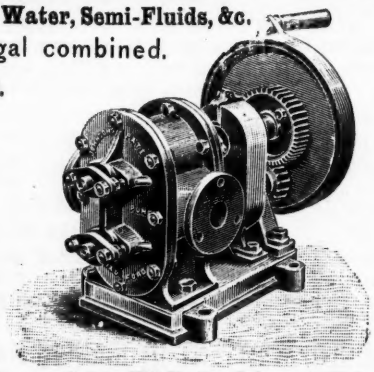

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Our Silica Bricks have gained a high reputation for Unsurpassed Quality in most of the leading Firms in England and on the Continent. Export orders delivered Liverpool, Hull, Grimsby, or the Tyne.

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Manufacture & supply best quality of

Gas Retorts (SEGMENTAL, HORIZONTAL, or INCLINED.)

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EVERY REQUISITE FOR GAS-WORKS. Retort Setters sent to any part of the Kingdom.

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MAXIM PATENT CARBURETTOR

FOR ENRICHING GAS IN BULK.

Over 50 Maxim Patent Carburettors have now been fixed, capable of enriching

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CUBIC FEET OF GAS PER DAY.

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More Gas and saleable Coke per ton of Coal Carbonized is produced; saving Capital Labour, Fuel, Wear and Tear, &c.

The Enrichment is **INSTANTANEOUS** and **PERMANENT.**

The Carburettor is inexpensive, easily fixed, and entirely supersedes the use of Cannel.

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Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—

1. Smooth interior, preventing adhesion of Carbon.
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ESTABLISHED 1836.

STEEL SCOOPS
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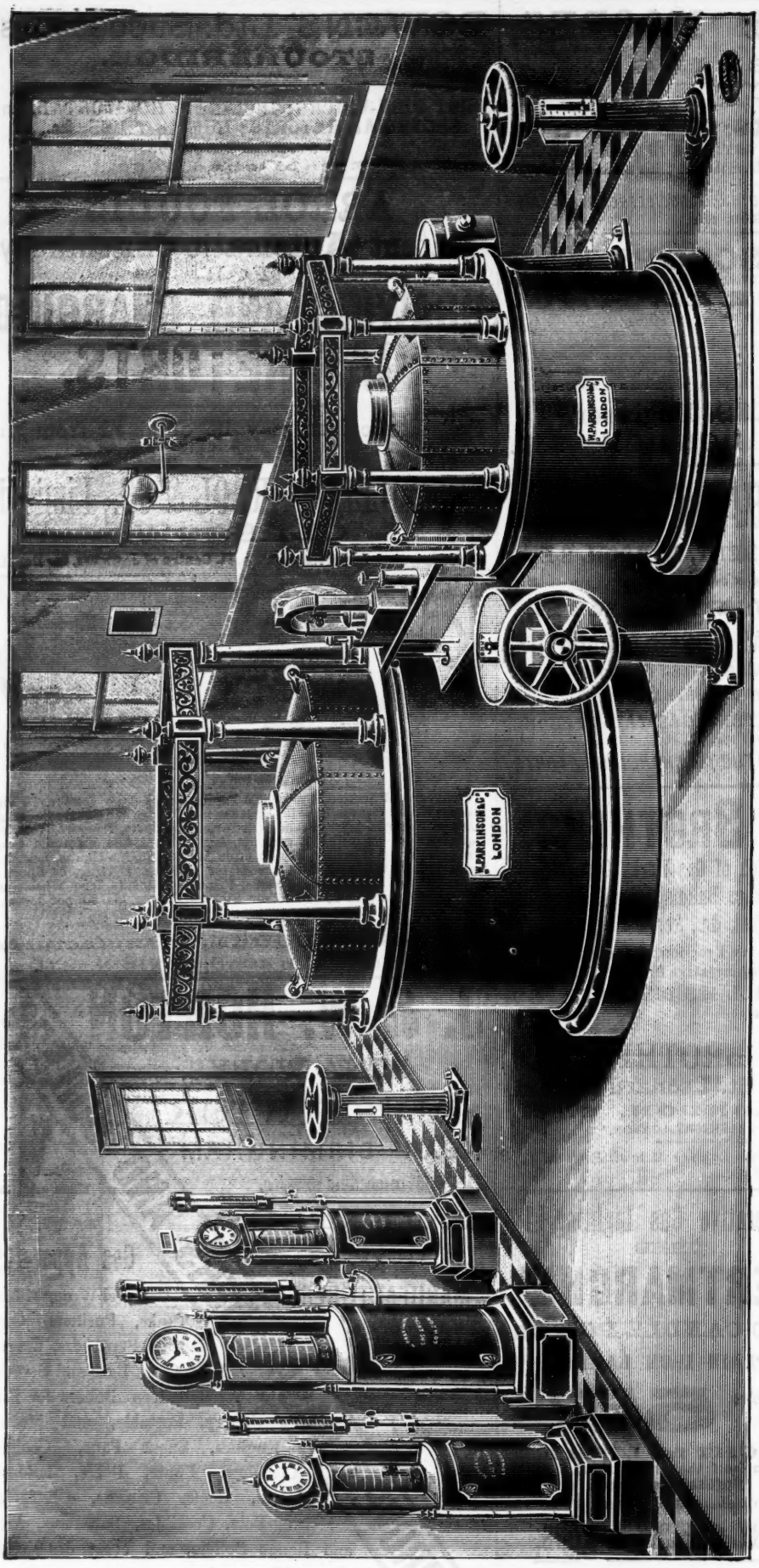

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(TESTIMONIAL.)

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I am, Gentlemen, Yours faithfully,

MESSRS. W. PARKINSON AND CO., (Signed) G. F. L. FOULGER, Distributing Engineer.
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(See also Advt., p. 12.

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